

ANNALS
OF
SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

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VOLUME LXXIX
JANUARY—JUNE 1924

PHILADELPHIA
J. B. LIPPINCOTT COMPANY
1924

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ANNALS of SURGERY

VOL LXXIX

JANUARY, 1924

No 1

SURGICAL SIGNIFICANCE OF ABDOMINAL PAIN

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OF THE many and varied surgical conditions which we encounter in the lumen, pain is the most important symptom and the one which more often influences the diagnosis and procedure than any other

To correctly interpret its meaning as a symptom, one must have a fairly intimate knowledge of the rather complex nerve supply of the entire abdomen and its contained viscera before its significance is fully understood. It is aside from the subject for discussion to go into the detailed anatomy and physiology of the nerve supply of the abdomen at this time. However, I feel that it will not be out of place to refer to the main sources of innervation. The abdominal parietes, front and sides, are supplied by the lower five or six intercostal spinal nerves which give off anterior and posterior branches and terminate by entering the substance of the rectus muscle on each side and giving sensation to the mid-front of the abdomen. The hypogastric region and lateral flanks are supplied by the last dorsal and branches of the ilio-hypogastric and ilio-inguinal nerves. It is interesting to note that the posterior wall of the abdomen receives its supply from the lumbar and sacral spinal nerves and not the dorsal. These branches are intimately connected with the lumbar and sacral plexi which lie on the posterior wall of the abdomen, and are in close relationship with many of the viscera which are the frequent site of disease and of which, when inflamed, pain is often the most conspicuous symptom. In addition to this, we have several large main nerve trunks entering the abdominal cavity which are closely connected with the other large distributing centres. The pneumogastriacs on each side of the oesophagus go to supply the stomach, the right to the posterior wall of the stomach, entering into the formation of the solar-plexus, and the left to the anterior wall. The sympathetic enters the abdomen as two large trunks beneath the pillars of the diaphragm and pass into the pelvis ending in the coccygeal ganglia, having entered into the formation of several small ganglia (four lumbar, four sacral) which are the connecting stations between the various large sympathetic abdominal plexi on the inner side and the spinal nerves externally. There are three other important trunks on each side passing from the thorax into the abdomen, *viz* the great, the small and smallest splanchnics which go to make up the semi-lunar ganglia and renal plexi. The phrenics, two other thoracic nerves, descending principally from the fourth cervical through their

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anastomotic branches communicate with the solar and hepatic plexi and in this way have visceral connections, but strictly speaking do not enter the abdomen but supply the diaphragm, a not infrequent seat of baffling pain from the standpoint of diagnosis

Next in consideration is that intricate interlacing of nerve fibres of the sympathetic system lying immediately upon the aorta, and at two points they are much more closely aggregated and constitute the great solar and hypogastric plexi. The epigastric or solar plexus is situated behind the stomach and in front of the aorta and crura of the diaphragm. It receives the great and small splanchnics and the termination of the right pneumogastric and supplies all of the viscera of the abdominal cavity from its ten distributing centres or lesser plexi.

The hypogastric plexus located in front of the fifth lumbar vertebra occupies the same relative importance to the pelvis and its organs as does the solar to the abdominal viscera. It will be observed that the nerve supply of the viscera and visceral peritoneum is derived from the various sympathetic plexi while that of the parietal peritoneum is derived directly from the spinal nerves (dorsal, lumbar, sacral and phrenics). The spinal nerves contain many more sensory fibres than do the sympathetic trunks. It is a long established clinical fact that the parietal peritoneum is much more sensitive to manipulation and the traumatism of surgery under local anaesthesia than is the visceral peritoneum, or in fact any of the viscerae. This fact must also be remembered from a diagnostic point of view.

Before going further, it is necessary to refer to the connection that exists between the visceral nerve supply and that of certain well-defined areas on the body surface supplied by the spinal nerves and related through the same spinal segment. The brilliant works of Head, Ross, MacKenzie and others, but Head in particular, has resulted in establishing the exact relationship between sharply defined cutaneous tracts and viscera receiving their nerve supply through the sympathetic, but from the same spinal segment as that received by the skin area. I quote from Head, "On disturbances of sensation with especial references to the pain of visceral disease" 1 * 1 "Pain was in many cases associated with definite cutaneous tenderness. Moreover, the cutaneous tenderness was in many cases not confined to small spots or areas, but occupied whole tracts of skin with definite tenderness. I was then led to investigate the pain and accompanying tenderness consequent on disturbances of other organs, and I found that these sensory disturbances also followed definite lines. After Ross' most suggestive papers it seemed exceedingly probable that these areas bore some definite relation to nerve distribution, and I then began to investigate the distribution of herpes zoster in the hope that a skin lesion which was notoriously of nervous origin might throw some light on the meaning and significance of tender areas in visceral disease. I next attempted to determine to what level of the nervous system these areas belonged, with the help of cases in which gross organic lesions were present. By this means it became apparent that each of these areas represented the distribution of a single nerve

root or of a single segment in the spinal cord. Thus I was enabled to map out the areas supplied by the various segments of the cord on the surface of the body. It then became apparent that certain of these areas were never affected in visceral disease, and this led me to examine the sensory supply of the viscera from the sympathetic system. Now Ross had already suggested that in visceral disturbances, pain (and therefore, in my cases tenderness) was referred along the distribution of the somatic nerves which come off from the same part of the cord as the sensory sympathetic fibres to the organ affected. Thus if I could map out the somatic areas along which pain was referred in visceral disease, I could say on Ross' hypothesis what was the sensory supply from the sympathetic of the particular organ affected. By this means I obtained another scheme showing the distribution of the sensory sympathetic fibres analogous to that which Gaskill constructed for the motor and inhibitory fibres of the same system."

It is interesting to note that in this surface topography, the cutaneous zones correspond more closely to segmental supply than to individual nerve supply, also the cutaneous zones are sharply defined and do not overlap as in the ordinary peripheral sensory supply to the skin. This most interesting work of Head's explains referred surface pain in visceral disease and enables us to follow it in many vague conditions to the affected viscera. Under normal conditions pain in the skin is located with accuracy at the point receiving the stimulant, as for instance a pin prick on any part of the body surface. This, to a large degree, is attributed by Howell to the temperature and pressure sense, and when these are lost or destroyed in the skin surface, pain is then very inaccurately located. "Pain arising in the internal organs on the contrary is located very inaccurately, but is often referred to points on the skin, and may be accompanied by areas of tenderness in the skin." Pain of this kind, when misreferred to the surface of the body, is designated as reflected pain. The explanation offered for this (Howell) misreference, is that the pain is referred to the skin region that is supplied by the spinal segment from which the organ in question receives its sensory fibres, the misreference being due to a diffusion in the nerve centres. As Head expresses it, "when a painful stimulus is applied to a part of low sensibility in close central connection with a part of much greater sensibility, the pain produced is felt in the part of higher sensibility, rather than in the part of lower sensibility to which the stimulus was actually applied."

It is interesting that affections of the serous cavities, *e g*, the peritoneum, do not cause reflected pains or cutaneous tenderness as in the case of the viscera. Another important fact in referred pain is its occasional occurrence in the symmetrical area on the opposite side of the body. This is sometimes seen in renal disease, ovarian lesions, tubal pregnancy and breast inflammation, and is explained on the basis that depression of the cutaneous sense in a given area with application of the stimulus to that point, will cause pain projection to the symmetrical area of the opposite side, if this is also involved it may be referred to the area next above or below in the spinal order. On

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more than one occasion we have found a stone in the opposite kidney or a rupture of the opposite tube in ectopic pregnancy to what was expected from the patient's localization of pain. The stimuli necessary to excite pain varies in different parts, for instance those for visceral pain are not of the ordinary thermal or tactile types to which skin and mucous surfaces respond so promptly, but is believed by most investigators to be entirely due to tension in some form or other. Meltzer has attempted to explain all forms of colic on the basis of what he terms "the law of contrary innervation," which in the normal physiological peristalsis of the intestine is fulfilled in the simultaneous relaxation that always occurs just below the contracting segment. When this simultaneous contraction and relaxation is interfered with by the presence of inflammation, new growth or other disturbing lesions, pain is the result. The contraction of unstriated muscle is the most frequent cause of abdominal pain and it is always referred along the midline of the abdomen somewhere from the ensiform cartilage to the pelvis. This is the reference segment for all of the hollow viscera, œsophagus, stomach, intestine—and includes bladder, uterus and bile ducts—while renal colic is distinctly unilateral in its reference.

When we come to consider the various surgical conditions of the abdomen which may be the cause of pain, we can only allude to the most important in a general way in the time at our disposal. Some of the lesions are chronic, others sub-acute and many are acute, depending upon the degree of severity and duration. Many acute conditions are but sudden and severe exacerbations of preexisting disease. It has been estimated that 90 per cent of all disease begins with, or is accompanied by pain sometime during its course. "Alone, pain indicates danger in general, in combination with other signs it indicates danger in particular and guides the surgeon's hand to its source." In many cases it is the most important symptom. In others, it is only an incident. Its location, the manner of onset, severity, duration, radiation, the relation it may have to certain events like the taking of food, micturition, defecation, etc., demand careful consideration in their interpretation. It may be worse at night. Its relation to other symptoms such as vomiting, etc., must be given due thought. For certain lesions the severity, character and location may be quite typical. Age, racial characteristics and sex are entitled to consideration. Women as a rule endure pain better than men because of lessened sensibility to painful stimuli, and the phlegmatic are more uncomplaining than those with a highly developed nervous system. It is a well established fact that in the aged there is occasionally an absence of pain in many of the lesions, such as appendical and gall-bladder inflammations which are ordinarily productive of a great deal of pain. This is explained on the basis that in senility the sensibility to painful stimuli is lost to a great degree and sometimes completely. In the obese patient, tenderness and rigidity may be diminished or absent from anæsthesia of the peritoneum as a result of fat deposit about the somatic nerve endings in the sub-serous space. The patient's interpretation of the character of pain may be of considerable value in arriving at the cause. Pain ought always to be regarded from two aspects. In the one, the untouched patient

manifests it, and in the other, the clinician elicits it. In the latter it is pain on pressure or tenderness which is always located about the seat of the lesion. Crile states: "Pain, like other phenomena, was probably evolved for a particular purpose, surely for the good of the individual, like fear and worry, it frequently is injurious. What then, may be its purpose? We postulate that pain is one of the phenomena which results from a stimulation of motor action." He also maintains that the only types of infection that are associated with pain are those in which the fixation of parts by continued muscular rigidity is an advantage, that the type of infection that may cause muscular action when it attacks one region of the body, may cause no such action when it attacks another. A striking instance of the protective action of pain is seen in acute abdominal infections such as peritonitis, where there is segmental rigidity of the recti muscles in localized infections or generalized rigidity in diffuse infections. Peristalsis is almost absent, food is refused or may be ejected, the dorsal position is assumed and is not often changed. Muscular action has an adaptive and protective purpose in these infections.

The perforating lesions of the stomach, duodenum, appendix and rarely the gall-bladder, cause that type of pain which should not be interpreted as meaning anything but the gravest sort of intra-abdominal lesion, the sudden onset, the terrific and unabating pain with board-like fixation of the abdominal muscles is characteristic. The pain of acute pancreatitis and mesenteric thrombosis are equally severe and may not be relieved by heroic doses of morphine. In these lesions, life is at once jeopardized by the intense suffering. In pancreatitis the pain is confined to the upper abdomen and nearly always passes with severity to the back. It is agonizing beyond endurance and frequently is the cause of collapse. In the gastric and duodenal perforations, the history of the patient's condition previous to acute onset will, in a majority of cases, suggest quite accurately the nature and location of the lesion. This is particularly true of duodenal ulcer, where pain comes on one, two or three hours after taking of food and which is gnawing or burning in character and is relieved by taking more food or alkalies for a time and is often described as hunger pain. The distinct periodicity to the pain and symptoms is another characteristic. In gastric ulcer pain is less characteristic as a rule, and is generally aggravated by taking food. It is burning or scalding in character, is usually felt about the ensiform cartilage and is frequently referred to region of twelfth dorsal vertebra.

In gall-bladder inflammation the pain is never so severe as that of the perforating lesions mentioned. A frank perforation of the gall-bladder with sudden soiling of the whole peritoneal cavity, as is seen in gastric or duodenal perforation, rarely occurs. When perforation takes place, it is usually walled off and because of its anatomic position, results in a localized inflammation. Pain is not so severe and is localized as is tenderness. In gall-bladder disease the character of pain may be variable. It may be that of an acute inflammation, the result of severe infection, which is accompanied by abdominal rigidity, tenderness and the other signs of acute inflammation, or it may be the pain

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of tension due to distention of the gall-bladder, chronic infection and the presence of stones. Tenderness in these cases can nearly always be elicited by palpation over the gall-bladder. Referred pain may exist with either of the above conditions. The pain of gall-stone colic is usually intense, recurring in violent paroxysms and is referred over the hepatic and epigastric regions and usually radiates to the back or right shoulder. Vomiting, with profound nausea, is nearly always an accompanying symptom. Rarely the pain is referred to the left side and back.

The pain of peritonitis is sharp, stabbing or lancinating in character. Patients frequently describe it as having "doubled them up." There is, of course, generalized tenderness and muscular rigidity over the involved peritoneum, and usually a point of maximum tenderness can be elicited about the site of the primary inflammation. Pain resulting from inflammation of the vermiform appendix is usually abrupt in onset. It is of varying degree in severity. It is usually referred to the epigastrium or around the umbilicus and after the lapse of a few hours usually becomes distinctly worse in the right iliac fossa. The sequence of pain to other events is of great importance in the diagnosis of appendicitis. Pain is always the first symptom, and if pain is preceded by vomiting you can almost certainly exclude disease of the appendix. The pain is apt to be colicky in character until involvement of the peritoneum takes place, when its character may be somewhat changed. It may seem a little out of place to refer to purgation in these cases, but having seen so many disastrous results from it, I cannot refrain from mentioning it. It is unquestionably the cause of most of the cases of peritonitis that we see resulting from this disease. If these patients are not purged there is the same tendency for the inflammation to remain localized even if perforation does occur, as is manifested in infections of the gall-bladder and pelvic appendages. Moynihan says that in appendicitis, perforation spells purgation, and in his large experience he pens the sequence of events in pain, aperient, perforation. He further says "I, therefore, do not hesitate to say that in almost every instance of acute peritonitis due to the perforation of the appendix it is the treatment directed to the relief of the condition that is the cause of the serious and so often fatal catastrophe." He has expressed himself most clearly and forcibly in an amended nursery rhyme

Perforation means purgation,
With the appendix kinked and bad,
Both food and drink will worry him
And aperients drive him mad

Diseases of the pelvic appendages in the female is a common source of pain. A bi-manual examination should never be omitted, especially when a woman complains of backache. An ovarian cyst, a pus tube, or a right ureteral stone is often diagnosed as appendicitis, and a lacerated cervix or perineum with a retroverted or prolapsed uterus treated for kidney disease or lumbago. Pain of these organs is often described as "bearing-down pain or

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heavy headache" Pain may also be reflected down the front of the thighs The pain of ruptured ectopic pregnancy is usually severe in character but does not approach the intensity of the perforating lesions that we have described The pain, of course, is more severe over the lower abdomen, and is occasionally located on the opposite side of the rupture Patients sometimes describe it as "if something had given way or had burst within the body" The pain of intestinal obstruction is usually sudden in onset It is violent in character continuous with fierce exacerbations The continuous pains are due to the constriction of the intestine and the exacerbations to the colic of an over-active peristalsis

The location of pain varies with the site of obstruction It has been shown by MacKenzie that the pain of obstruction is always located along the mid-line of the abdomen, the zone for the small intestine embracing the umbilical region corresponding to the levels of the costal margin above and the crest of the ilium below, while that of the large intestine occupies the hypogastrium One may be aided in the localization of this pain by remembering that it begins well above the point of obstruction, gradually passing lower and lower until it reaches a climax If, when the pain stops, this point be noted, the situation of the obstruction can be localized within certain limits Unfortunately the limits are still wide, nevertheless, the information is extremely useful as an aid to diagnosis

The pain of tuberculous peritonitis and localized tuberculous processes is not in any way characteristic, but is usually either sharp and stabbing in character like that experienced in other infections of the peritoneum, or else it is colicky in type due to interference with peristalsis or involvement of the intestinal tract There are many other less common surgical lesions of the abdomen, including ureteral calculi, intestinal tumors, mesenteric cysts, eroding and ruptured aneurisms and typhoid perforations, etc., which we will not take up

In the examination of a patient for the purpose of eliciting pain or tenderness, one must not forget the influence of position on pain in the various organs The occurrence of a painful position points to a localized process. This is frequently found to exist even when the pain appears to be diffuse as in acute appendicitis Painful position may be present in cancer, gall stones or stone in the pelvis of the kidney The lateral position is frequently found to be painful for it involves the most favorable conditions for abnormal displacement and traction if tumors or adhesions are present The influence of motion is of considerable value in acute inflammatory and suppurative conditions of the abdomen as when the patient anxiously maintains the dorsal position and carefully avoids turning to either side A transmitted jar from walking or going down steps will frequently cause pain when there is present a pyonephrosis and appendicial abscess or acute inflammation of the gall-bladder

In the consideration of abdominal pain one must keep constantly in mind the many extra-abdominal conditions which so closely mimic many of the

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acute abdominal lesions. Among the most conspicuous of these are the referred pain of pneumonia, pleurisy, diaphragmatic infections, acute dilatation of the heart, gastric crisis of tabes dorsalis, acute coxitis of children, spondylitis, herpes zoster and angina pectoris. The abdominal symptoms of the latter condition is sometimes described as angina abdominis. Some of the more common non-surgical intra-abdominal conditions such as lead poisoning, acute gastritis, colitis, etc., may be excluded in the diagnosis of a surgical lesion by careful history taking and a proper correlation of symptoms with thorough physical examination. There are conditions in which a positive pre-operative diagnosis cannot be made other than that of an acute abdominal catastrophe. In these cases, with the use of all diagnostic means at hand, accurate interpretation of history and symptoms and a proper display of surgical judgment, a timely operation may be performed or an operative casualty averted.

Some one has classified the causes of pain into (1) muscular, such as is seen in the passage of ureteral or biliary calculi, (2), that caused by irritants of a chemical or microbic nature, such as is seen in peritonitis from perforation of a gastric or duodenal ulcer or gangrenous appendix, (3), from undue distention of encapsulated organs such as the liver, spleen, pancreas, kidneys, ovaries, etc. This distention may be due to abscess or cystic formation, or the infiltration of new growth or inflammation, and lastly where the source is found in the invading process of an aneurism where the pressure is from without or there is erosion and exposure of nerve trunks.

When we remember that these complicated plexi and network of nerve trunks, leading to and from the abdomen conveying all kinds of nervous impulses, some motor, some sensory, many secretory and others vasomotor, and maintaining such an intricate relationship one with the other, and all with the whole nervous mechanism, it is well nigh impossible not to believe that when any material disturbance is brought to bear upon a particular plexus, through undue stimulation of a part supplied by its nerves that a much wider effect must be produced than would otherwise be the case, if no such association existed. With such considerations in mind, it is possible to see some explanation of the many and varied phases which the same disease may present in different individuals. In one case motor derangement may feature the disturbance, and in another it will be altered secretions, and in still another sensory or vasomotor symptoms will predominate.

I wish to make grateful acknowledgment to such authorities as Head, MacKenzie, Ross, Crile, Moynihan, Howell, Meltzer and Richardson, whose works I have used freely in the preparation of this paper.

ENDOTHERMY IN THE TREATMENT OF ACCESSIBLE NEOPLASTIC DISEASES*

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To us as medical men, not the least interesting feature of the history of electricity is the fact that much of the original experimentation has been done by physicians. Ever since Dr. William Gilbert published in 1600 his work "De Magnete"

and laid the foundations of modern conceptions of electricity, physicists and physicians have been attracted by this great force and its possible service to man. Nearly two hundred years later Galvani, an Italian physician and professor of anatomy, accidentally discovered the muscular contractions produced by the current to which he gave his name, and before the middle of the nineteenth century about the time that Faraday was announcing his discovery of induction Joseph Henry, an American, described the oscillatory character of

the discharge from the Leyden jar. Henry not only understood the oscillatory nature of these waves, but proved experimentally that a spark about one inch in length from the prime conductor of an electrical machine to a wire circuit in an upper room, produced inductive effects capable of magnetizing needles in a parallel circuit placed in the cellar, although this was thirty feet below the upper floor and separated from it by two floors each fourteen inches thick.

This demonstration did not attract further attention until it was taken

* Read before the Medical Society of the County of Queens, April 24, 1923.

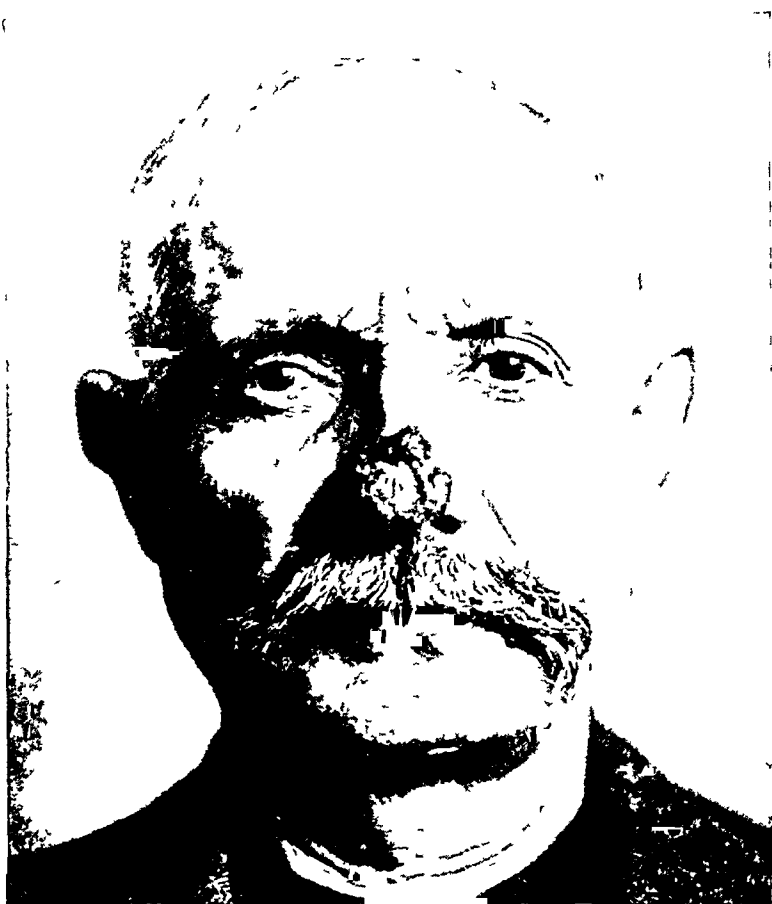


FIG. 1 — Basal cell epithelioma of nose. Given single treatment by monopolar endothermy under local anæsthesia on June 26, 1922.

GEORGE A WYETH

up by Hertz in 1888, when he succeeded in producing a series of electric oscillations of very high frequency. Whereupon D'Arsonval showed that muscular contractions cease with 10,000 oscillations per second and this number has therefore been taken as the dividing line between currents of high frequency and low frequency. In demonstrating the lack of effect of such oscillations on motor or sensory nerves, he used an apparatus which was first suggested by Sir Oliver Lodge.

Doyen, whose researches on the penetration of heat began in 1896, presented to the French Surgical Congress in 1907, a well-thought-out method

of destroying accessible cancer by electro-coagulation, and one of his important conclusions was expressed as follows: "Of all means employed in the destruction of pathological tissues the only certain method is that of heat."

Colwell, in his book "History of Electrotherapy and Diagnosis," tells us, "The actual production of heat within the tissues themselves, as the result of the passage of an electric current of high frequency was first suggested by Nikola Tesla in 1891. D'Arsonval, in February of that year, made a communication to the Societe de Biologie



FIG 2—Patient shown in Fig 1. Picture taken on July 10 1922 fourteen days after treatment showing lesion completely healed. No recurrence to date September 1 1923.

in which he stated the possibility of passing a high frequency current of three amperes through the body with no other sensation than that of heat, and in 1908 Nagelschmidt, at the Buda-Pesth Congress demonstrated a specially designed apparatus for producing this heating effect and introduced the name *Diathermy*."

This was fifteen years ago, and those of us who are now working with neoplastic growths, feel that too much time has been wasted in contradictory literature and vague nomenclature. This is partly because neither apparatus nor technic has been standardized and because much of the work has been done by specialists in other fields, whose limited leisure gave little chance for the development of skill in the use of these special instruments.

Neoplastic diseases are of many forms and of varying degrees of violence, and before the practitioner can be successful in their treatment by high frequency currents, he must be wise in the currents' prescription and expert in their application. We cannot be either wise or expert if we are inexact. We must not talk of fulguration, high frequency cauterization, desiccation, electrothermic cautery, sparking, thermo-penetration, the electric needle and coagulation as if they were all words indicating more or less the same process.

Nagelschmidt's use of the term "surgical diathermy" represented an effort at exactness, but we need consider it only a moment to realize that it is both limited and limiting. Nagelschmidt knew nothing of desiccation, that more important branch of endothermy, which was devised and has been so brilliantly developed by Dr. Wm. L. Clark of Philadelphia. In the old technic of Doyen and Nagelschmidt a round plate blunt electrode was used for the active electrode which caused needless widespread destruction and was moreover, beyond the control of the operator. This old technic is still used by many, but it is not employed in endothermy.

Of desiccation, or *monopolar* endothermy, Doctor Clark writes:

"Desiccation should not be confused with fulguration, or with high frequency cauterization, or coagulation. Desiccation devitalizes by drying the tissue, fulguration shocks and produces hyperæmia but does not destroy, high frequency cauterization is essentially the same as the ordinary cautery, though perhaps deeper in effect. It is possible to produce all thermic degrees ranging from hyperæmia to cauterization. The desiccation spark is not hot enough to carbonize, but is of sufficient heat to cause rapid dehydration of the tissue, rupturing the cell-capsule and converting the area treated into a dry mass. Desiccation destroys tissue without opening blood or lymph channels and will act as a styptic when there is oozing of blood."

Dr. W. Benham Snow has said "Oscillatory desiccation as practiced by



FIG. 3.—Large basal cell epithelioma of eight years duration at inner canthus of left eye involving upper and lower lids and conjunctiva over inner aspect of eye. Treated by monopolar endothermy under local anæsthesia.

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Doctor Clark requires a more precise technic with more skillful adjustment of apparatus than is required for fulguration and it is generally more successful "

Dr George Pfahler says "Fulguration is never used to destroy tissue If the profession will get that one fact clear we shall have much less confusion in our literature "

For the sake of further definiteness, the writer has chosen to employ the word *endothermy*—*monopolar* and *bipolar* This expresses both phases of the work and indicates its particular technic Endothermy is the localized produc-

tion of heat in the tissues from within in response to the many oscillations of a high frequency current and it is always executed with a sharp-pointed active electrode It is the purpose of this paper to outline the accomplishments of endothermy in the destruction of neoplastic diseases

I suggest that this is of particular and peculiar interest to us all on account of the prevalence and high mortality of these cases We know we can best control them by the employment of local attack Systemic treatment has been discredited Local attack may take either one of



FIG 4—Same patient shown in Fig 3 Showing good cosmetic result after removal of lesion Eyesight unimpaired

two forms, physical or surgical Under physical attack we place radium and X-ray, both of which have made and are daily making splendid records of relief and cure of neoplastic diseases Both agencies can accomplish many of the results of endothermy but not so quickly nor so surely in those cases to which the latter method is applicable This rapidity of healing is well illustrated by Fig 1 Two weeks after removal of the malignancy by monopolar endothermy new and healthy skin covered the site of the lesion and there has been no recurrence in the fifteen months which have since elapsed

Considering the entire range of malignancy the best hope of the patient doubtless remains in the surgeon's knife But under surgical attack we include endothermy which has, over ordinary surgery, in accessible cases, the

enormous advantage of destroying the malignancy before removing it. It is impossible to overestimate the importance of the fact that with endothermy we remove the growth as a necrotic mass instead of as a group of viable cells, and thus tend to eliminate the danger of mechanical dissemination. The truth would seem to be that the varied forms of malignancy make necessary a highly specialized treatment, and it is as reckless to treat every case by X-ray as it would be to treat every case by radium or to treat every case by endothermy. The best results undoubtedly flow from wise selection and use of whatever agency, or combination of agencies may be indicated.

An important difference between endothermy and all other methods of cauterization by heat is that in endothermy the active electrode is *cold* when applied, *ie*, the applicator is cold when applied. Heat comes from within by the resistance of the tissues to the current. It is therefore progressively penetrating according to the amount of current used and the length of time it is applied. This progressive penetration is in contradistinction to heat applied from without, as with the actual cautery, the cold cautery or the galvano-cautery.

The three most important neoplastic diseases are tuberculosis, benign and malignant growths, and syphilis. The latter is mentioned merely to call attention to the fact that old chronic ulcerated specific lesions which have resisted treatment, often yield quickly to endothermy. This is true, also, of condylomata.

Endothermy's greatest field of usefulness is the treatment of accessible malignancy and precancerous conditions, but the method acts so surely and so beneficently in the treatment of tubercular lesions of the skin and mucous membranes that it may be considered almost a specific. This seems but little known to the profession, and when it is generally understood we shall secure better results with these most resistant cases. It should be borne in mind endothermy is a destructive process and its destructive effect can be produced



FIG 5 —Large, basal cell epithelioma of left ear involving cartilage

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at any desired depth. Here our endeavor is to carry it to the depth of the tubercle bacilli and destroy them *in situ*. Case IV, illustrated herewith, shows a lupus vulgaris in a boy of fourteen. For ten years this had resisted every effort at eradication, but the lesion healed kindly after destruction of the tubercle bacilli by monopolar endothermy under local anæsthesia.

A lesion of tuberculosis cutis, tuberculosis verrucosus cutis and tubercular ulcer should heal rapidly after being destroyed by one treatment of monopolar endothermy. Disseminated miliary lupus and lupus vulgaris, as well as lupus erythematosus, are, on the other hand, generally more diffuse and require a



FIG. 6—Same as Fig. 5 after treatment by monopolar endothermy under $\frac{1}{2}$ per cent novocaine. Note good cosmetic result.

number of treatments. Here a single area is destroyed at a time until the whole lesion is completely treated. At each treatment the epidermis over each localized area is dehydrated and peels off at once. A further penetration of the heat into the corium and subcutaneous tissue is then produced by lightly contacting with the needle. The depth to which this is carried depends upon the amount of current and length of time applied. Shortly after there is a pouring out of serum with subsequent crust formation. Under this protective crust nature restores herself.

In the lighter and more superficial neoplastic growths where the lesion is localized and does not extend into the depth of the tissues, marked destruction is not indicated and to employ surgical diathermy here would be like lifting a pebble with a crowbar. Monopolar endothermy is our method, used under local anæsthesia, preferably freshly prepared one-half per cent novocain. The result is desiccation.

The technic is easy. With the monopolar current, a current of high voltage and low amperage, from an Oudin resonator of a high frequency machine we induce in the tissues just enough heat to cause a localized dehydration. This is done with an ordinary sewing needle held in a suitable handle. Our new machines allow us to employ the heat where we will and to what degree we will in all accessible lesions. Throttled down to a pinpoint area we

can work in the cornea of the eye or on the vocal chords. For this work our needle should only touch or rather lightly penetrate the lesion to be destroyed, and we have found the method unsurpassed for removing those small tumors of the eyelid which can be taken off at their bases without destroying the surrounding tissue. The treatment is followed by practically no scar formation and consequent ectropion. This superior cosmetic result follows because, though endothermy is a destructive process, it neither chars the flesh nor burns it, and there is therefore only slight secondary inflammation. For this reason it is especially valuable in the removal of lesions about the face, neck and

hands. Warts, moles, pigmented nevi, papillomas, keratoses, those commoner blemishes which unsightly in themselves, are menacing because they may become malignant, all are easily removed by endothermy. Doctor Pfahler says "He who has once seen a mole treated by this method will not think of using any other by preference. The results are prompt, not very painful and beautiful." The many kinds of warts are taken off without troublesome hemorrhage, and particular mention should be made of the ease and permanence with which that some-



FIG 7 —Lupus vulgaris, ten years duration

time persistent plantar wart with its underlying spongy layer, is eradicated by this treatment. That obstinate condition, leucoplakia also responds to the brushing over of this current, as does vernal catarrh. Varicose ulcers and old, chronic, indolent ulcerations which are sluggish in healing often respond rapidly to a treatment by endothermy. Here we thoroughly desiccate all old stubborn granulating tissue and curette down to a healthy base. The heat sterilizes the wound and by removing all obstructive debris we give nature a fresh start. Cases II and III show, respectively, epithelioma of eyelid with inner canthus, and ear. Both of these were treated by monopolar endothermy under local anaesthesia, according to the technic just described. In each case nature's healing was prompt and uninterrupted and the cosmetic result highly satisfactory. Particular interest

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attaches to each of these. To the first because the conjunctiva over inner aspect of eye was involved and, but for the delicacy with which endothermy was employed, patient's eyesight might have been impaired or destroyed. To the second because here endothermy proved its applicability to a lesion involving cartilage. Such a growth as this is very difficult to excise with the knife and does not readily react to treatment by radium or X-ray.

Many patients who have had protracted X-ray treatment—and many workers with X-ray and radium—develop a keratosis which may become epitheliomatous. These cases often prove most obstinate in handling, and it is



FIG 8 —Same patient as in Fig 7. Lesion healed after treatment by monopolar endothermy under local anesthesia.

a pleasure to report, therefore, that a record of these keratoses treated by endothermy shows a very high percentage of apparent cure with splendid cosmetic result.

For the removal of deep-seated malignancy, bipolar endothermy is employed, and the use of the more powerful currents in deep penetration make complete anaesthesia advisable. The preferred anaesthetic is ether, but it must, of course, be taken from the room while the current is in actual use.

We secure the intense, penetrating action of this endogenous heat by the use of the D'Arsonval

or bipolar current—a current of low voltage and high amperage. The result is coagulation. Heat is generated by connecting one pole of the machine to a well-wet, indifferent electrode under the patient's buttocks as he lies upon the table. The other pole—the active electrode—is attached to a handle in which is a sharp-pointed darning needle of proper length and suitable shape.

The first step in the technic of endothermy is to describe in the healthy tissue a ring of destruction necrosis around the malignant area. That is, before the malignancy is touched it is completely surrounded by a wall of coagulation necrosis which isolates the growth and shuts off the blood-vessels and lymphatics to and from the affected part. A specimen for section can now be taken with impunity, after which the malignant area is destroyed *in situ*.



FIG 9.—Epidermoid carcinoma of lower lip two and one-half months duration. Age seventy-six years



FIG 10.—Same after removal of carcinoma, following its destruction by monopolar endothermy. Note how completely nature will restore a lower lip

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The operator must learn just how much or how little current shall be used and for how long, bearing in mind always the wisdom of overtreating rather than under-treating. This same wall of necrosis drawn in healthy tissue to shut off blood-vessels and lymphatics cuts off also the sensory nerves. This brings about that prompt alleviation of pain which is one of the remarkable features of treatment by endothermy. How important is this result in that large group of so-called inoperable cancer! Though used in such cases without hope of cure the treatment is highly valuable if it bring relief from suffering. Brief mention must also be made of the grateful effect of the intense

heat upon a foul discharging area, an effect of sterilization and cleansing.

After the lesion has been completely destroyed it is either curetted away, or removed by scissors, as an inert mass. The base is then seared over with the current to assure a further penetration by the heat and to secure a perfectly dry wound. Dosage is always under accurate control of the operator and if the work is properly done there should be no hemorrhage. Should a bleeding point

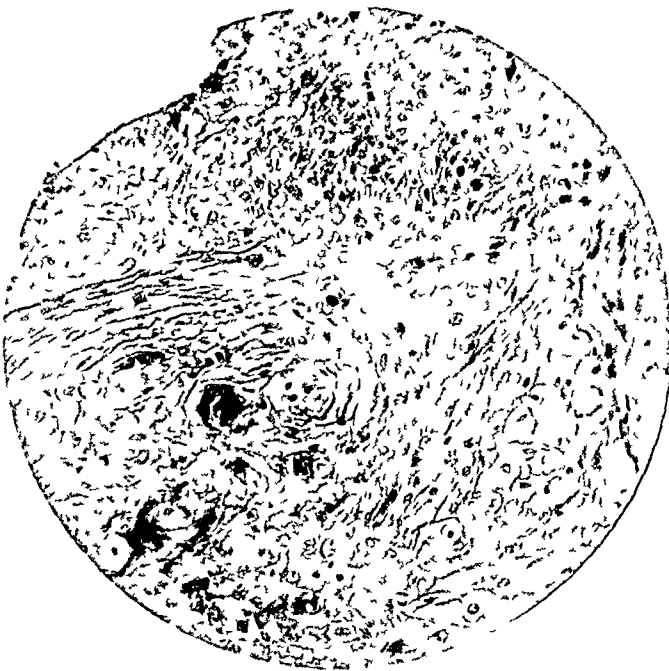


FIG. 11 — Microphotograph of epidermoid carcinoma of lower lip

be encountered, it is generally controlled by focussing the current on it for a second or two. Secondary hemorrhages rarely occur, but because they have happened in isolated cases, I should take the precaution to do a preliminary ligation were I working in close proximity to a large blood-vessel.

In the squamous-cell variety of epithelioma and the more malignant forms of accessible cancer, particularly in lesions in and about the mouth which metastasize early, are difficult of removal by the knife and are uncertain in their response to physical treatment endothermy is of the very highest value. Endothermy does not act through the induction of any tissue change, endothermy destroys, and this destruction is as effective on the lesion of a squamous-cell epithelioma as on the lesion of the slow-growing basal cell, provided the growth can be surrounded by our ring of protective necrosis, and provided metastasis has not already taken place. Because of the great danger of metastasis in cases of squamous epithelioma no treatment of a lesion of this kind can be considered complete until there has been thorough

radiation of the lymphatics draining the affected area. This post-operative or pre-operative prophylaxis is never more important than in glandular involvement of the neck which so often complicates lip lesions. The lesion is easily removed in a single treatment under local anæsthesia, but radiation of the glands may need be repeated. In illustration of a case of extensive squamous-cell epithelioma of lower lip is shown Fig 9. This growth was removed in a single treatment, and the second photograph shows how completely nature will restore the soft lip tissue once the malignancy has been destroyed by endothermy.

By endothermy any portion of a tongue can be coagulated and immediately removed, or it may be amputated without splitting the cheek. A floor-of-the-mouth cancer can be coagulated *in situ* and removed in one operation, making possible that early return to normal diet which is so highly important in these cases since most of these patients are anæmic, cachectic and badly run down. Bony structures, alveolus, hard palate, and portions of the lower jaw can likewise be treated and removed, for this endogenous heat can be made to penetrate bone as well as soft parts.

Furthermore, endothermy's applicability to all lesions of the body surface and of accessible cavities also covers conditions of the hollow viscera, such as the bladder, which can be opened surgically, treated with endothermy and immediately closed. In the treatment of bladder tumors the writer no longer attempts to remove by means of the cystoscope any, except small papillomas where the entire base can be seen. In all other operable cases the invariable rule is to make a hypogastric incision and then with an electric light in the bladder bringing the lesion into full view to destroy and remove the tumor at its base after the technic of monopolar endothermy. This offers a far better chance of complete eradication.

When we come to summarize the advantages of endothermy we find that by its quickness and cleanness of application, its accuracy of dosage, its reduction of the dangers of metastasis and the likelihood of recurrence, the rapidity of convalescence and the good cosmetic results it has made for itself in the treatment of accessible neoplastic diseases a place which no other agency can fill.

In conclusion I desire to express my thanks to Prof. John A. Fordyce for his kindness in furnishing me material in his clinic.

ENCAPSULATED ADENOMATA OF THE THYROID

IMPROVED TECHNIC FOR THEIR REMOVAL

By JOSEPH L. DeCOURCY, M.D.

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ADENOMATA are probably the most frequent tumor of the thyroid. In certain localities, they form as high as ninety per cent of all goiters. We have found this to be true in northern Indiana, following a series

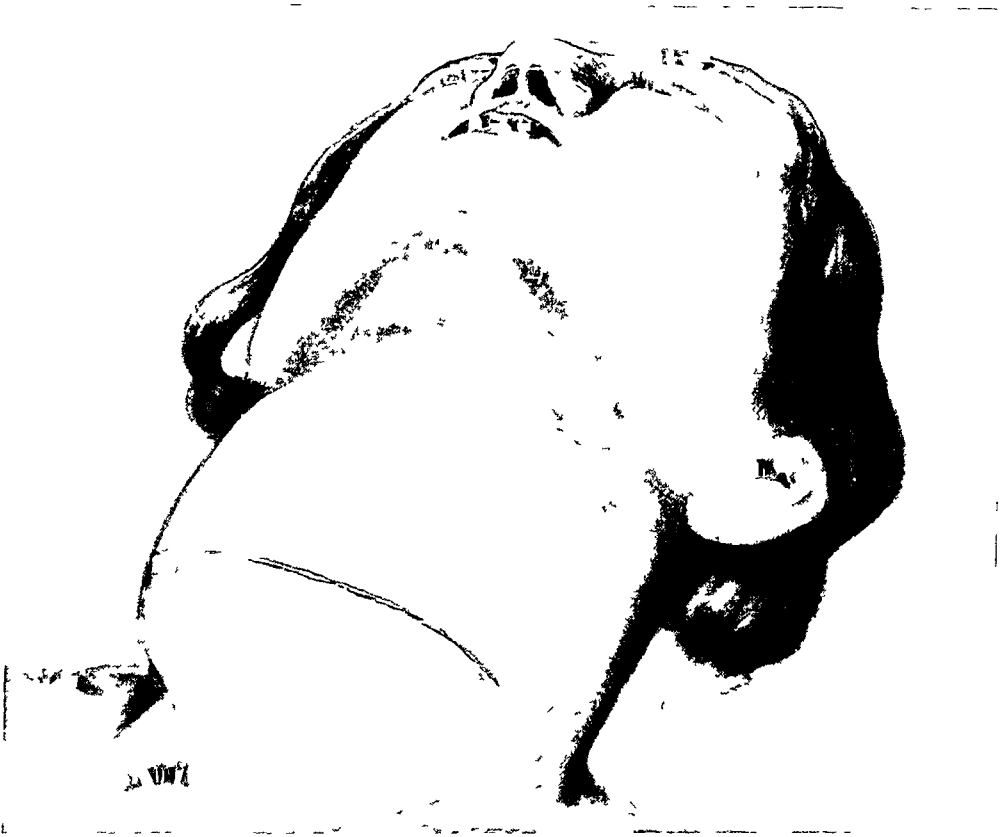


FIG. 1.—Skin incision

of 750 examinations. In southern Ohio the percentage is lower, varying between forty and fifty per cent in a series of 3000 examinations.

Their size is variable, occasionally becoming as large as a grapefruit, the majority, however, vary between the size of an egg and a large orange, of either or both lobes.

As an adenoma increases in size, its capsule increases in thickness, seemingly nature's way of preventing disruption. In the smaller variety the

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capsule is usually thin, and therefore of less importance to the surgeon. Adenomata in pushing forward in their growth carry the capsule in front of them, exerting pressure in front and to some extent laterally. For this reason the denser adhesions between the capsule and the tumor itself, occur over the outer half of the growth. We have found this to be especially true when



FIG 2 —Opening of capsule at base of tumor

operating, and frequently dense adhesions are found overlying the growth when the capsule is opened above, and the operation becomes extremely difficult. This is especially true also when patients have had a series of X-ray exposures, as we so frequently see nowadays.

In order to overcome this difficulty I have devised the technic which is so readily seen from examining the drawings. Instead of opening the capsule at the uppermost portion of the tumor, a small opening is made at the lower portion. The capsule is then separated from the gland and hæmostats placed



FIG 3 —Division of anatomical capsule between clamps



FIG 4 —Division of capsule continued upward

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above and below the line of incision The incision is carried up both sides from below until the adenoma is completely enucleated



FIG 5 —Division completed exposing structures beneath

The advantages are as follows

- 1 Area of adhesion formation is avoided
- 2 Hemorrhage is entirely controlled
- 3 Capsule does not have to be trimmed away after removal of tumor
- 4 Operation can be performed very much more rapidly
- 5 There is less trauma

THE BACTERIOLOGY OF EXTIRPATED TONSILS AND ITS RELATION TO EPIDEMIC TONSILLITIS*

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SINCE the theory of focal infection became an established fact through the work of Billings and his co-workers, the tonsil has been considered an important point of entrance for microorganisms. The microbes, especially the streptococci, attack the organs in two ways, through the circulation, causing various diseases, and through the respiratory tract causing pneumonia and other diseases of the respiratory organs. Cumming, Spruit, and Aten have demonstrated that the throats of 35 per cent of patients with measles, and of 94 per cent of patients who develop bronchopneumonia with measles, harbor hæmolytic streptococci. According to Tongs, the number of streptococci in the throats of persons who have had tonsillectomy is far smaller than in those whose tonsils have not been removed. Lillie and Lyons have found notable improvement in 79 per cent of patients with arthritis, after tonsillectomy alone. Benjamin and Quirk have reported beneficial results after tonsillectomy in an interesting case of orchitis that followed follicular tonsillitis. Schmitz, Davis, Lent and Lyon, Nichols and Biyan, and Pilot and Davis have studied the bacteriology of the crypts of tonsils. All found that the *streptococcus hæmolyticus* was the predominating organism. Davis states that the crypts are covered with a spongy layer of large epithelial cells through which microorganisms can readily pass. Wood has demonstrated that *bacillus anthracis* passes through the lining of the crypts into the parenchyma of the tonsils of pigs, resulting in necrosis of the tissues and invasion of the circulation through the dilated inflamed capillaries, and that invasion does not occur through the mucous membrane of the mouth.

Owing to the marked seasonal variation in the incidence of tonsillitis and other infections of the upper respiratory tract, Doctor Rosenow suggested that I study carefully the bacteriology of extirpated tonsils over a long period, in order to determine the incidence and number of the various types of streptococci and other bacteria in the tonsillar tissue.

Through the cooperation of the staff of the Section on Otolaryngology, of the Mayo Clinic, I have studied the bacteriology of 2048 tonsils removed from July 1, 1922, to June 30, 1923. The tonsils were removed on account of recurring attacks of tonsillitis or, more often, because they were believed to be foci of infection in patients suffering from ulcer of the stomach, chronic infectious arthritis, myositis, cholecystitis, nephritis, and so forth. One tonsil from each patient was placed immediately in 10 per cent formalin, the other was sent to the laboratory for cultures.

* Work done in the Division of Experimental Bacteriology

BACTERIOLOGY OF EXTIRPATED TONSILS

TECHNIC

The tonsils were examined grossly to determine thickness of capsule, consistency, and evidence of infection in the crypts, in from one to four hours after enucleation. They were then washed several times in sodium chlorid solution, placed in sterile petri dishes with the crypts down, and about twenty drops of 70 per cent alcohol were sprinkled on the surface, after which they were again washed in sodium chlorid solution. Sterile scissors with sharp points were stabbed through the capsule into points of fluctuation, avoiding the crypts, and the scissors were then opened, making a large hole through the capsule. Cultures from the pus which usually exuded, or from the material which was pressed out with sterile forceps, were made routinely on the surface of blood-agar plates and in tall tubes of glucose-brain-broth. These were incubated at 36.5° C for from eighteen to twenty-four hours, when the character of the growth was noted. In the case of the blood-agar-plate cultures, the number of colonies of the various types of streptococci was determined, together with other organisms. In many instances, anaerobic cultures on blood-agar slants were also made.

GROSS AND MICROSCOPIC FINDINGS

The size and consistency of the tonsils varied greatly. In many instances, pus was expressed from the crypts, and on section one or more abscesses were found near the capsule, even though the patient had not had symptoms referable to the tonsils, and when examination *in situ* was largely negative. The pus was greenish-yellow and usually showed large numbers of organisms in smears. The material pressed out of the crypts often contained small particles resembling the granules of actinomycosis, but which on microscopic examination were found to consist of large numbers of microorganisms and necrotic desquamated cells. In a relatively small number of the tonsils, usually from children, the chief change was hypertrophy, abscesses were rarely found in these, but thin pus often was expressed which revealed large numbers of streptococci and other bacteria in smears.

RESULTS OF GLUCOSE-BRAIN-BROTH CULTURE

In the glucose-brain-broth cultures the streptococci predominated. Sometimes a small number of staphylococci and Gram-negative bacilli were also found. Growth nearly always began at the bottom of the tube within eight to nine hours, and it had nearly always grown to the top in from eighteen to twenty-four hours. In most instances the growth was granular, with deposits along the sides of the tube and early precipitation, although occasionally diffuse turbidity was produced. When the growth was granular, long chains and clumps of streptococci varying in size and in reaction to Gram stain were found, whereas in those that showed diffuse turbidity, diplococci and short chains of more uniform size were found, all of which were Gram-positive. In smears from the bottom of the tubes, especially in those with marked involution forms and which were incubated for more than twenty-four hours, variations in staining reaction were noted. Certain organisms were very large, and others extremely small, even in the same chain, the former usually being Gram-positive, the latter Gram-negative. Frequently blood-agar plates of the cultures in glucose-brain-broth yielded a predominating number of green or indifferent colonies of streptococci, and relatively few or no hæmolytic streptococci, even when the primary plating revealed many hæmolytic and few indifferent colonies.

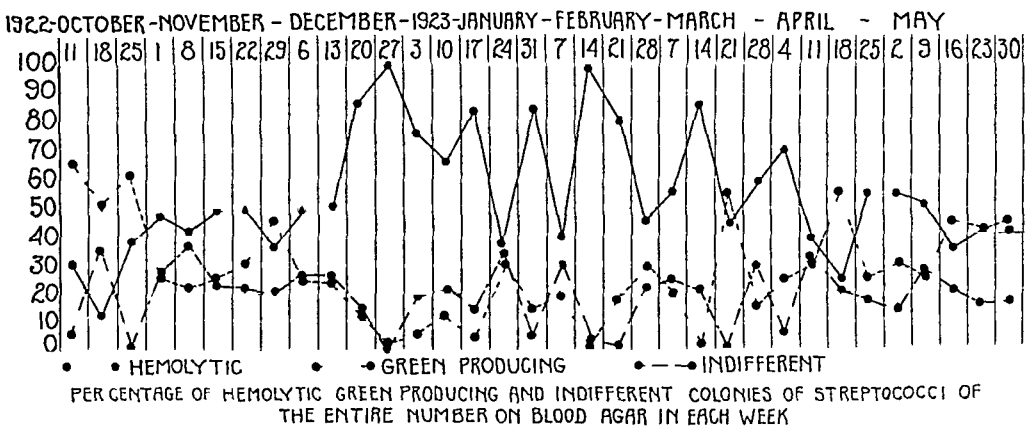
RESULTS OF BLOOD-AGAR-PLATE CULTURES

The streptococci were classified into three main types (1) the hæmolytic streptococcus, with a small, usually dry, granular colony, sometimes elevated,

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sometimes flat and spreading, and surrounded by a wide zone of complete hæmolysis, (2) the green-producing streptococcus, which produced usually small, grayish, somewhat dry, elevated colonies, more rarely flat, moist, slightly spreading colonies, which usually revealed a greenish tinge on transmitted light, and were surrounded by a narrow zone of partial hæmolysis, and (3) the indifferent streptococcus which produced small, dry, grayish colonies that had no effect on the medium. The number and proportion of the types varied greatly. A careful record of the number of each type of colony on blood-agar plates was made from October 11, 1922 to May 30, 1923, they varied from one to countless numbers. This includes the results obtained from 1,250 tonsils from as many patients. Fifty-two per cent of the entire number revealed hæmolytic, 58 per cent green-producing, and 18 per cent, indifferent streptococci, alone, or with other types.

The average number of colonies of the types of streptococci that developed on the blood-agar plates by weeks was determined. In instances in which they



were innumerable, the arbitrary figure of 3000 was used for the calculation. The percentage of the types of streptococci compared with the total number obtained on blood-agar plates is given in the chart. The percentage of the different streptococci was similar during the period of observation, but varied according to the change in the seasons. Thus, during three weeks in October, the green-producing colonies predominated. The curve is depressed until the latter part of May, when it rises, whereas the curve representing the percentage of hæmolytic streptococci is low during October, rises to a relatively slight predominating level during November and the early part of December, and then to a still higher level, where it remains until the early part of April, when it drops to a low level. The curve representing the indifferent type of streptococci was usually the lowest throughout the time of observation. The total incidence of the isolation of the types of streptococci in general agreed with the percentage incidence, and varied considerably from week to week and according to season. Eighty-four tonsils yielded the streptococci in pure culture, fifty-one of which were hæmolytic, twenty-seven green-producing, and six indifferent. The thermal death point of 115 strains of the streptococci isolated was tested. It was found that fifteen minutes at from 56° to 60° C sufficed to kill in every instance.

VIRULENCE OF THE STRAIN

The virulence of the types of streptococci was of a relatively low order. Of six mice injected intraperitoneally with 2 cc of the primary culture in glucose-brain-broth, five died, of twenty-eight injected with 1.5 cc, five died, of twelve injected with 0.75 cc, three died, of four injected with 1 cc one died, and of

BACTERIOLOGY OF EXTIRPATED TONSILS

five injected with 0.5 c.c., one died, all from peritonitis. The rabbits injected with from 5 to 6.5 c.c. of the primary culture usually survived, but on examination lesions were found in a high percentage in organs corresponding to those affected in the patient from whom the tonsils had been removed. The detailed results of the animal experiments will be reported elsewhere.

In 841 tonsils, microorganisms other than streptococci were studied also. Staphylococci were frequently found in large numbers and usually were hæmolytic, *Micrococcus catarrhalis* was found in 570 (68 per cent), the number of colonies varied greatly, but was usually large. *Staphylococcus albus* was found in 254 (30 per cent), *staphylococcus aureus* in seventy-two, *staphylococcus citreus* in six, colonies resembling *bacillus influenzae* were found surrounding streptococcus or staphylococcus colonies in seventy-five, *bacillus diphtheriae* was found in thirty, *bacillus coli* in forty, *bacillus Friedlander* was found in large numbers in twenty-three, and *micrococcus tetragenus* was found in eighteen. The pneumococcus was not usually differentiated from the green-producing colonies of streptococci, but in some instances fermentation of inulin was determined. Search for acid-fast bacilli was made in smears of the pus or other material obtained from the tonsils in about 100 cases, but the bacilli were not found in a single instance.

FERMENTATIVE POWER OF THE STREPTOCOCCI

All of the fifty strains of hæmolytic streptococci from the tonsils of fifty patients fermented glucose, thirty-four fermented saccharose, thirty-three lactose, sixteen raffinose, eleven inulin, sixteen salicin, and eight mannite. Thirty-five produced acid in milk, twenty-seven of these also causing coagulation. All of the fifty-four strains of green-producing streptococci from the tonsils of fifty-four other patients fermented glucose, forty-seven fermented saccharose, fifty-one lactose, thirty-six raffinose, twenty-two inulin, twenty-four salicin and eight mannite. Forty-seven produced acid in milk, thirty-seven of which also caused coagulation.

DISCUSSION AND CONCLUSIONS

A point of particular interest regarding the results of the cultures is the relative increase in the number of hæmolytic streptococci which occurred in December and lasted throughout the winter months. At about the time when the hæmolytic streptococci became predominant, an epidemic of tonsillitis and some throat developed in Rochester, continuing until about the middle of April, when the relative number of hæmolytic streptococci became noticeably less. The patients from whom the tonsils were removed had no acute inflammation of the tonsils at the time of tonsillectomy, nor was there a history of attack shortly before. In view of the fact that most of these patients came from widely separated regions, there is reason to believe that the increase in hæmolytic streptococci during the winter months occurs generally, and that the increased incidence of hæmolytic streptococcus tonsillitis is due more to climatic conditions than to contact infection. It is well known that accidental infections incident to surgical operations, usually due to hæmolytic streptococci, are more prone to occur during epidemics of infections of the upper respiratory tract. This study demonstrates that the number of hæmolytic streptococci in the tonsils of persons without history of actual infection becomes unusually large during the winter months when tonsillar infections are prevalent, and it warrants the suggestion that extraordinary care be taken to prevent con-

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sterilization of instruments, the field of operation, and so forth, from the mouths of the personnel of the hospital operating rooms

From my study, it may be concluded that streptococci occur more commonly and in larger numbers than other bacteria in the parenchyma of extirpated tonsils. The incidence and relative number of hæmolytic streptococci increase with the coming of cold weather and the prevalence of tonsillitis and allied conditions

BIBLIOGRAPHY

- ¹ Benjamin, J D, and Quirk, T C Orchitis Complicating Acute Follicular Tonsillitis U S Nav Med Bull, 1921, vol xv, pp 406-407
- ² Citron, J Die Tonsillen als Eingangspforte von Infektionen Munchen Med Wchnschr, 1919, vol 11, p 763
- ³ Cumming, J O, Spruit, C B, and Aten, E J Streptococcus Pneumonia Jour Am Med Assn, 1919, vol 1411, pp 704-707
- ⁴ Davis, D J Experimental Study of Bacteria Isolated from Tonsils Jour Am Med Assn, 1920, vol 14, pp 26-27
- ⁵ Davis, D J The Tonsil in Relation to Infectious Processes Jour Am Med Assn, 1920, vol 1414, pp 317-320
- ⁶ Davis, D J Chronic Streptococcus Arthritis Jour Am Med Assn, 1923, vol 141, pp 724-727
- ⁷ Lent, E J, and Lyon, M W, Jr Bacterial Flora and Weights of a Series of Excised Tonsils Ann Otol Rhinol and Laryngol, 1921, vol xxx, pp 545-550
- ⁸ Lillie, H I, and Lyons, H R Tonsillectomy in Myositis and Arthritis Jour Am Med Assn, 1919, vol 1411, pp 1214-1216
- ⁹ Nichols, H J, and Bryan, J H The Tonsils as Foci of Infection in Streptococcus Hæmolyticus Carriers Jour Am Med Assn, 1918, vol 141, pp 1813-1814
- ¹⁰ Pilot, I, and Davis, D J Hæmolytic Streptococci in the Faucial Tonsil and their Significance as Secondary Invaders Jour Infect Dis, 1919, vol xxiv, pp 386-399
- ¹¹ Schmitz, H Bakteriologische Untersuchung von operativ entfernten Tonsillen Centralbl f Bacteriol Orig, 1919, vol lxxxi, pp 538-540
- ¹² Tongs, M S Hæmolytic streptococci in the nose and throat Jour Am Med Assn, 1919, vol 1411, pp 1050-1053
- ¹³ Wood, G B Tonsillar infection Am Jour Med Sc, 1914, vol cxlvii, pp 380-388

A STUDY ON FOCAL INFECTION AND ELECTIVE LOCALIZATION IN ULCER OF THE STOMACH AND IN ARTHRITIS*

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It is well known that a small number of certain microorganisms of low virulence may circulate in the human body and not cause symptoms, but if they lodge and multiply in organs, or become virulent, symptoms develop, as in staphylococcal osteomyelitis or gonorrhoeal gonitis. Various facts indicate that bacteria rarely enter the blood stream through the normal skin and mucous membrane, but that entrance is prone to occur when these tissues become the seat of lesions, traumatic or inflammatory, and that when tissues, such as the tonsils, for mechanical reasons, harbor large numbers of microorganisms, invasion probably occurs at frequent intervals. The bacteria may establish colonies in certain organs, produce secondary foci, and thus overcome the resistance of the host, so that systemic disease results. Such processes are generally defined as "focal infection."

Billings^{1, 2, 3, 4} has emphasized the importance of focal infection in arthritis, nephritis, and endocarditis. Davis made a special study of the microorganisms in tonsils excised for a variety of clinical conditions, including chronic arthritis, nephritis, endocarditis, recurring tonsillitis, and neuritis. Rosenow^{12, 13, 14, 16, 17} produced lesions in the stomach, duodenum, appendix, gall-bladder, iris, skin, joints, muscles, nervous system, endocardium and kidney of rabbits by injecting streptococci or pneumococci from infected tonsils and teeth of patients who were or had been suffering from the corresponding diseases.

Many patients with ulcer of the stomach, arthritis or other diseases believed to be focal in origin, improve or recover after complete removal of foci. Lillie and Lyons, in a study of 200 cases of myositis and arthritis, found that 79 per cent of the patients improved markedly after tonsillectomy. The organs in which the primary foci are usually found are tonsils, teeth, sinuses, gall-bladder, intestines, appendix, cervix, seminal vesicles and prostate.

Certain microorganisms tend to invade certain tissues. The gonococcus attacks large joints and tendon sheaths, and the meningococcus invades the meninges. In acute multiple suppurative myositis, staphylococci attack the skeletal muscles with a narrow specific affinity¹¹. Jackson^{7, 8} produced

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arthritis and myocarditis in rabbits by the injection of a streptococcus isolated from epidemic sore throat, which disease was frequently accompanied by myocardial and joint infections. Irons, Brown and Nadler produced iritis by the injection of streptococci from cases of iridocyclitis. Rosenow¹⁵ found that iritis and other ocular lesions developed following intravenous injection of streptococci only when they were of a particular grade of virulence.

Certain species of bacteria especially the streptococcus, attack many organs, and when injected into animals may localize in joints, in the mucous membrane of the stomach or duodenum, in muscles, heart, kidney, central and peripheral nervous systems, gall-bladder, and so forth. But not all of these organs are attacked by the same strain. Rosenow^{13, 14, 16} found that bacteria, especially the streptococci taken from original or secondary foci of patients suffering from ulcer of the stomach, arthritis, appendicitis, and so forth, have specific affinity for the stomach, the joints, the appendix and so forth, respectively, and on the basis of these findings he has propounded the theory of elective localization.

I have studied the bacteriology of extirpated tonsils and the localizing power of the bacteria isolated in a series of selected cases of arthritis and ulcer of the stomach observed in the Mayo Clinic from July 1, 1922, to June 30, 1923, and I shall report here the results of animal experiments in cases of ulcer of the stomach and of arthritis, and in control cases. The results of the cultures will be reported elsewhere.

TECHNIC OF EXPERIMENTS

The extirpated tonsils were washed in sterile sodium chlorid solution, and material for culture was obtained from the pus or from the material pressed out with sterile forceps after puncturing the capsule with sterile scissors. This was plated on blood-agar and inoculated into tall tubes of glucose-brain-broth. In most cases the glucose-brain-broth culture yielded streptococci alone, sometimes also staphylococci, *Micrococcus catenhalis*, or other bacteria. As a routine, the eighteen-hour culture, incubated at from 35° to 36.5° C, was used for injection in a 5 cc dose for medium size or full-grown rabbits, the injection was made in the marginal vein of the ear, each animal receiving one injection. The culture was inverted just before injection for the purpose of mixing the bacteria, because the localizing nature of those at the top and those at the bottom might not be the same. The culture on blood-agar plate was not used, because long exposure to oxygen destroys the localizing property of the streptococcus.¹⁴ From forty-eight to seventy-two hours after injection, the animals were chloroformed and examined closely for changes in the eyes, endocardium, myocardium, pericardium, lungs, liver, gall-bladder, bile stomach, duodenum, appendix, intestines, spleen, kidneys, urinary bladder, muscles of the trunk and extremities, knee, shoulder and elbow joints, and the bone-marrow of the tibia. Cultures were made from each organ and from the blood. When an ulcer or hemorrhage was found in the stomach, the infected area was cut out and placed in 10 per cent formalin, or washed with sterile sodium chlorid solution and emulsified in a sterile manner, then inoculated into the culture mediums, glucose-brain-broth and blood-agar.

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Sometimes the pus from the tonsil was suspended in sodium chlorid solution and injected into rabbits, usually in doses of from 2 to 5 c c

The cases for animal experiments were carefully selected. Only those were studied in which the tonsils were septic and in which active symptoms of ulcer of the stomach had developed a short time before, or chronic cases in which recent exacerbation of symptoms had developed.

ILLUSTRATIVE CASES (ULCER OF THE STOMACH)

CASE IV—A man, aged forty years, came to the Clinic November 11, 1922, on account of stomach trouble which he had had for twenty-five years. The symptoms, which recurred at intervals of from three to four months, consisted of indigestion, gas, dull pain occurring about an hour after meals, nausea, vomiting, belching, and occasionally hæmoptysis and tarry stools. In January, 1921, a diagnosis of duodenal ulcer had been made, and the teeth were found to be septic. In June, the patient came to the Clinic, posterior gastro-enterostomy and appendectomy were performed, and a special diet was prescribed. The gastric symptoms disappeared until the latter part of October, 1922. Rontgenograms revealed an ulcer along the lesser curvature of the stomach. December 7, five infected teeth, and January 9, 1923, four teeth were removed. February 3, tonsillectomy was performed. By February 12, the symptoms referable to the stomach had disappeared, and rontgenograms of the stomach were negative. July 10, the patient still felt well but returned for examination. He had gained 20 pounds, and rontgenograms of the stomach were negative.

Hæmorrhage or ulcer, or both, of the stomach were found, with no lesions elsewhere, in the two rabbits injected with pus from the tonsil, in the two injected with the primary culture in glucose-brain-broth, and in the two injected with the sodium chlorid solution washings of the apices of two infected teeth. Four controls, two injected with sodium chlorid solution, and two with sterile glucose-brain-broth, did not have lesions. The four injected with the primary culture in glucose-brain-broth from the teeth revealed multiple hæmorrhages and ulcer of the stomach, one also had a vegetation on the tricuspid valve, one, hæmorrhages in the muscles of the leg and abdominal wall, and one, turbid fluid in the knee joints. The two injected with the second culture of one of the teeth remained free from lesions, whereas the two injected with the third subcultures had slight lesions of the stomach.

Four rabbits were injected with the strain from one of the teeth in the primary culture and second animal passage, two receiving 5 c c of the glucose-brain-broth culture, and two 0.2 c c diluted with 5 c c of sodium chlorid solution. The first two died, they had marked lesions of the stomach, one also had hæmorrhages in the abdominal muscles. The other two appeared well the day after injection, one had three hæmorrhagic ulcers in the stomach, no lesions were found in the other. Two that received the same strain in the second subculture had lesions of the stomach. Three that were given the cleared glucose-brain-broth of the third subculture were free from lesions. Two rabbits receiving the strain in the third animal passage had hæmorrhage of the stomach, one also had an ulcer and hæmorrhage in the tricuspid valve. The two injected with the strain in the fourth animal passage were found dead on the third day, both with hæmorrhage and ulcer of the stomach, one also had hæmorrhagic œdema over the base of the lungs, and the other, numerous hæmorrhages of the appendix.

TABLE I
Results of Experiments with Nine Strains from Patients with Gastric Ulcer or Hemorrhage

Case	Age (years)	Sex	Duration of symptoms	Severity of attack	Date of last attack	Date of tonsillectomy	Character of streptococcus	Animal experiments	
								Number injected	Positive
1	39	F	16 years	Marked (hemorrhage)	June 1922	June 27 1922	Viridans	2	2
2	47	M	15 months	Moderate	Nov 1922	Jan 2 1923	Viridans	5	3
3	21	M	3 years	Moderate	Jan, 1923	Jan 9 1923	Viridans	6	3
4	40	M	25 years	Moderate	Jan, 1923	Jan 9 1923 (teeth removed) Feb 3, 1923	Viridans (teeth and tonsils)	29	24
5	40	M	17 months	Marked (hemorrhage)	Jan 1923	Jan 29 1923	Viridans	9	6
6	39	M	5 years	Slight	Jan, 1923	Feb 1, 1923	Viridans	4	2
7	32	M	8 months	Moderate	Feb 1923	Mar 21, 1923	Viridans	2	0
8	48	F	8 years	Moderate (hemorrhage)	Apr, 1923	June 11, 1923	Hemolytic	5	3
9	33	M	15 months	Marked (hemorrhage)	May, 1923	July 16, 1923	Hemolytic	4	3
Total								66	$\frac{46}{(70\%)} \frac{20}{(30\%)}$

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One of three rabbits injected with an emulsion of the tonsils in sodium chlorid solution developed hemorrhage and ulcer of the stomach, the other two did not have lesions. The two injected with the primary culture from the extirpated tonsils had marked lesions of the stomach, and one also had embolic lesions in the kidneys, and turbid joint fluid.

Comment—The points of particular importance in this case are the temporary effectiveness of gastro-enterostomy in the face of focal infections, the disappearance of gastric symptoms, and the roentgenograms negative within one month after the removal of foci containing streptococci with elective affinity for the mucous membrane of the stomach.

CASE IX—A man, aged thirty-three years, came to the Clinic in May, 1923, on account of recurring attacks of stomach trouble, associated with tarry stools. Rontgenograms of the stomach and intestines were negative. A diagnosis of obscure gastro-intestinal hemorrhage was made. The patient's tonsils were septic. June 25, an exploratory laparotomy revealed chronic appendicitis, and the appendix was removed. July 16, tonsillectomy was performed. About two weeks later the patient appeared to be well. The cure was attributed to the tonsillectomy.

Cultures of the extirpated tonsils yielded hæmolytic streptococci. Three cubic centimetres of a sodium chlorid solution suspension of the pus from the tonsils was injected into two rabbits. At necropsy, a hemorrhagic area was found on the lesser curvature of the stomach of one rabbit, the other was free from lesions. The glucose-brain-broth culture of the pus from the tonsil was injected into two other rabbits. Necropsy disclosed hemorrhages in the mucous membrane near the cardiac end of the stomach of one rabbit. In the other rabbit were found two bleeding ulcers on the lesser curvature of the stomach, turbidity of the fluid around the left knee joint, an abscess in the right kidney, and many punctate hemorrhages in the lungs.

Comment—The points of special interest in this case are the cessation of gastric symptoms after tonsillectomy, and the production of hemorrhagic lesions of the stomach in the rabbits.

SUMMARY OF RESULTS IN THE ULCER EXPERIMENTS

Of the nine patients with gastric symptoms selected for animal tests, five had undoubted ulcer findings and four had severe hemorrhages, presumably due to acute ulcers. The main clinical facts in the cases, and the incidence of lesions in the stomach of rabbits injected are summarized in Table I. Seven of the patients were men, and two women. The ages ranged from twenty-one to forty-eight years. The duration of symptoms was from eight months to sixteen years. Exacerbation of symptoms occurred at about the time of, or within three months prior to, tonsillectomy. Gross evidence of infection of tonsils was found in all. *Streptococcus viridans* predominated in the cultures injected in seven, and slightly hæmolyzing streptococcus in two of the cases. Elective localization occurred in all but one of the former and in both of the latter.

Strains from nine patients with ulcers of the stomach were studied experimentally. Seventy-three rabbits were used, seven of which were controls. Of the sixty-six rabbits injected with the strains from tonsils, forty-six (70 per cent) had hemorrhage or ulcer, or both, in the mucous membrane of the

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stomach (Table II) Only one of the nine strains gave negative results on animal injection Lesions occurred in the pylorus in twenty (43 per cent) of the positive rabbits, along the lesser curvature in eighteen (40 per cent),

TABLE II
Incidence of Lesions in Various Organs

Source of streptococci	Number of strains	Number of animals injected	Stomach or duodenum Per cent	Joint Per cent	Muscle Per cent	Heart Per cent	Kidney Per cent	Lungs Per cent
Gastro-duodenal ulcer	9	66	70	30	2	6	4.5	8
Arthritis	19	97	29	85	9.2	12	10	1
Normal control	55	102	25.5	24.5	12.5	9.5	9.5	2

along the greater curvature in ten, and in the fundus in thirteen This incidence corresponds in general to the occurrence of ulcer in these regions in man A streptococcus similar to that found in the pus from patients' tonsils and in extirpated tonsils was isolated from both the hemorrhagic and the



FIG. 1.—Section of hemorrhagic ulcer of the stomach in rabbit forty-eight hours after intravenous injection of the streptococcus from ulcer. Hematoxylin and eosin (X 60)

ulcerated areas in the stomach of the rabbits In three of the animals, staphylococci and *Micrococcus tetragenus* also were found Cultures from excised areas of adjacent normal mucous membrane, if thoroughly washed, were generally free from streptococci, and only occasionally showed *Bacillus coli* and *Bacillus subtilis*

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Besides lesions of the stomach, hemorrhages and vegetation on the right tricuspid valve in four rabbits, hemorrhages in the lungs in five, turbid joint fluid in nineteen, from ten of which the streptococcus was isolated, hemorrhagic lesions of the kidneys in three, and hemorrhage in the skeletal muscles of one were noted. The ulcers were about 0.25 cm wide, and varied from 0.25 to 0.5 cm in length. They were usually superficial and covered with blood. The small ones occurred in groups of from three to five, and when the blood clot was rubbed off only slight gross defects in the epithelium could be detected, or none at all. In the larger ones, which were usually situated on the lesser curvature near the pyloric ring, the ulceration was found to be marked after the blood clot was removed.

The microscopic changes in the lesions consisted mainly of a variable degree of sharply localized interstitial infiltration by erythrocytes, leucocytes, eosinophils, and round cells, which often extended two-thirds of the length of the tubule, rarely to the muscularis mucosæ. In the areas in which the lesions had progressed to ulceration, disintegration of gland cells and an accumulation of leucocytes within dilated vessels in the submucosa, surrounded by a zone of greatly dilated capillaries, poorly-staining nuclei in the tubule cells, and granular cytoplasm were almost constantly found (Fig 1).

FIG 2 —Diplococci in the deep layer of the infiltrated sloughing tissue shown in Fig 1. Gram (X 1000)

Sections stained by Gram's method revealed large numbers of diplococci in the deep layers of the blood clots and in the infiltrated desquamating tissue (Fig 2), and fewer of the organism in the deep layers of marked cellular infiltration, there were no bacteria in the normal tissues.

The incidence of non-specific lesions of the ulcer and arthritis strains was about the same as that of the control strains. It paralleled closely that obtained by Rosenow and may be regarded as a measure of the relative susceptibility of various organs to bacterial invasion, since it corresponds roughly to the incidence of spontaneous infections in these organs, and of the potential invasive power of bacteria in foci of infection. The element of specificity in the ulcer and arthritis strains may thus be expressed by the difference between the total incidence and the incidence of non-specific strains, or 34 per cent for the stomach strains and 61 per cent for the joint strains, respectively.

The exceptionally large number of punctate hemorrhages in the mucous membrane of the stomach in the animals injected with the strains from the patients with recurring gastric hemorrhage without demonstrable ulcer, and the prompt disappearance of the patient's attacks following removal of the

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tonsils, indicate that focal infection and elective localization may be a common cause of this somewhat obscure condition

The results in the animals and the prompt recovery of the patient in Case IV after removal of foci, support the view that foci of infection are often responsible for recurring ulcer, and that the possibility of infection may play an important part in the causation of ulcer along the line of closure following gastro-enterostomy, which is now generally believed to be due to suture material¹⁰

ILLUSTRATIVE CASES OF ARTHRITIS

CASE I—The patient, a man aged thirty-six years complained chiefly of backache which had persisted at irregular intervals for three years. Rontgenograms revealed hypertrophic arthritis of the lumbar spine. The tonsils and several teeth were infected. Tonsillectomy was performed, and the green-producing streptococcus was isolated from the extirpated tonsils.

Two rabbits were injected with the culture in the second, third and fourth animal passages. In general the findings were similar, consisting of increased fluid around the elbow, shoulder and knee joints and a variable degree of turbidity of the joint fluid. In three of the rabbits punctate hemorrhages were found in the stomach and in one small abscesses in the kidneys. *Streptococcus viridans* was isolated from the turbid joint fluid.

CASE II—A woman aged forty-five years had had a pain in her shoulder for several years, which had been relieved by tonsillectomy for one year, when it recurred. She also had had pain in her feet and ankles. About seven years later, gall-bladder symptoms developed and cholecystectomy and appendectomy were performed. The patient grew worse, and biliary drainage was instituted affording temporary relief from the symptoms. Colon bacilli, staphylococci and streptococci were recovered from the bile. A diagnosis of infectious arthritis was made. A moderate number of *Streptococcus viridans* and a few staphylococci were recovered from the bile after biliary drainage.

The culture of the streptococcus was injected into five rabbits. All of the rabbits developed lesions of the joints, and turbid fluid was found in the knee joints of four, and in the shoulder and elbow joints each of two. Periarthritic hemorrhages, hemorrhages of abdominal and psoas muscles, hemorrhagic ulcer of the mucous membrane of the stomach, and thickening of the wall of the gall-bladder were each found in two rabbits, one also had endocarditis. A moderate number of streptococci were found in the joints of two of the rabbits, and in the hemorrhages of the muscles, in the bile, and in the thickened part of the gall-bladder of two.

A vaccine was prepared from the streptococcus which was recovered from the bile and the knee joint of one of the rabbits. After the second injection of vaccine, the patient was able to walk without a cane. At the end of one month, she was much better and could walk and move her arms almost normally. Three months later she had almost entirely recovered.

CASE III—A woman, aged fifty-four years, had had frequent, recurring pain in both knee joints for about eleven years. The pain finally became almost continuous. A diagnosis was made of hypertrophic arthritis and septic tonsils. The tonsils were removed, and hemolytic streptococci were recovered from them in predominating numbers.

Four rabbits were injected. All of them had turbid fluid in the knee joints, two in the shoulder joints, and two in the elbow joints. Slightly hemolyzing streptococci were isolated from the affected joints. Besides the articular lesions,

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vegetation of the heart valve was found in two, and hemorrhage of the mucous membrane of the stomach in two

CASE IV—A man, aged forty-eight years, had had pain in his left shoulder for several months. The trouble gradually involved all joints, the knee and the ankle joints, which swelled occasionally, caused the most pain. Infectious arthritis was diagnosed. Tonsillectomy was performed, and the culture from the tonsils yielded long-chained, green-producing streptococci.

Six rabbits were injected, four of which developed articular lesions. Turbid fluid was found in the knee joints and shoulder joints of three, and in the elbow joints of two. Two rabbits had periarticular hemorrhages, four had hemorrhages in the mucous membrane of the stomach, and one had a hemorrhage in the appendix. *Streptococcus viridans* was isolated from the turbid fluid in the joints of three rabbits, and from the periarticular hemorrhage of one.

SUMMARY OF ARTHRITIS EXPERIMENTS

The ages of the patients with arthritis and rheumatism ranged from thirty to sixty years. The symptoms, usually aggravated by changes in weather, varied in duration from three months to ten years. The knee, shoulder, and wrist joints were most often involved, the small joints and the lumbar spine less often. History of recurring attacks of tonsillitis was rare. The extirpated tonsils revealed evidences of moderate or severe infection, some contained abscesses, and all had a thickened fibrous capsule.

Many of the rabbits remained quiet for a short time after injection, but afterward appeared well, moved about, and ate normally. In these, only slight lesions of the joints, and moderately turbid joint fluid were found. Others sat humped up and were disinclined to move. Hopping appeared painful, and they spared the extremities, in which, after death, marked lesions of the joints were found. If death occurred from the streptococci, it was usually on the second or third day, never later than the fourth.

The joints attacked showed swelling of the periarticular tissues, such as ligaments, tendons and tendon sheaths, and muscles. The swelling was due chiefly to oedema and often was accompanied by streaks of hemorrhage or congestion of capillaries around the joints. The hemorrhages were mostly found on the anterior aspect of the knee joints. They were linear, and situated parallel to the course of the tendons. When the lesions were not severe, these external articular changes were not manifest, even though the joint fluid was turbid. For the examination of lesions within the joints, the articular ligaments were cut in a sterile manner on the stretched side, at right angles to the longitudinal axis of the bones. The free fluid in the joints, if increased in amount, immediately exuded, sometimes it was hidden in the recesses of the joints, but could be pressed out. In one case the joint capsule of the elbow had become perforated and the pus penetrated between the muscles of the foreleg. Hemorrhages were found only once on the internal aspect of the joint structures. The fluid in the normal joints was clear and not increased in amount, but that in the involved joints was increased, and ranged from slight turbidity to the consistency and turbidity of pus, often containing a good deal of fibrin.

TABLE III
Results of Agglutination Experiments with Immune Serum, Prepared with One Strain of the Streptococcus Viridans from Arthritis

Case	Diagnosis	Source of streptococcus	Character of streptococcus	Immune serum		Dilutions										Normal serum										Dilutions										Sodium Chloride solution																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
				I	50	I	100	200	500	1000	2000	5000	10000	I	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

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Serum prepared with the same strain after preservation in glycerin for three months									
1898	Arthritis		Joint of rabbit	Viridans	++	++	+	+	0
1898	Arthritis		Tonsil	Viridans	+++	++	++	+	0
1899	Chronic infectious arthritis		Tonsil	Viridans	+++	+++	+	+	0
1899	Chronic infectious arthritis		Joint of Rabbit 1	Viridans	+++	+++	+	+	0
1899	Chronic infectious arthritis		Joint of Rabbit 2	Viridans	+++	+++	+	+	0
1833	Multiple arthritis		Joint of rabbit	Viridans	+++	+++	+	+	0
1915	Rheumatic pains		Tonsil	Viridans	++	++	+	+	0
1916	Recurring arthritis		Tonsil	Slightly hæmolytic	++	++	+	+	0
1917	Arthritis		Tonsil	Viridans	++	++	+	+	0
1922	Arthritis spine	lumbar	Tonsil	Viridans	++	++	+	+	0
1922	Arthritis, spine	lumbar	Knee joint of Rabbit 1	Viridans	++	++	+	+	0
1922	Arthritis spine	lumbar	Knee joint of Rabbit 2	Slightly hæmolytic	+++	+++	+	+	0
1923	Arthritis		Knee joint of Rabbit 3	Slightly hæmolytic	+++	+++	+	+	0
1930	Hypertrophic arthritis		Knee joint of rabbit	Slightly hæmolytic	++	++	+	+	0
1930	Hypertrophic arthritis		Knee joint of Rabbit 1	Slightly hæmolytic	+++	+++	+	+	0
1944	Control strain		Viridans	Viridans	+++	+++	+	+	0
			Viridans	Viridans	++	++	+	+	0
			Hæmolytic	Hæmolytic	0	0	0	0	0

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The majority of the cells in the turbid articular fluid were polymorpho-nuclear neutrophilic leucocytes, there were relatively few lymphocytes and endothelial cells, and no erythrocytes. Endothelial cells were sometimes found in the clear fluid. Streptococci were never found directly in smears, their existence was proved only by culture.

The articular surfaces of the bones were normal in joints in which the fluid was clear, whereas in the joints in which it was markedly turbid, the cartilaginous surfaces were dull and rough and sometimes covered with a fibrinous layer. The discovery of the bacteria in the fluid was quite irregular, sometimes a clear, relatively scanty fluid produced a good growth in the medium, whereas at other times in a large quantity of fluid, no living bacteria were found. Generally, however, the streptococcus was found more easily and abundantly in the increased turbid fluid. Often when many joints were attacked in one animal, one or two of the joints failed to yield streptococci in the culture medium.

Ninety-seven rabbits were injected in the experiments on arthritis, 85 per cent of which developed lesions of joints and turbid fluid. In seven rabbits, periarticular hemorrhages were found, and in one each, a hemorrhage in the interior of one joint, and hemorrhage in the lung. Lesions of the heart, consisting of vegetation or hemorrhage on the tricuspid valve, occurred in 12 per cent, ulcer or hemorrhages in the mucous membrane of the stomach in 28.7 per cent, hemorrhages or abscesses in the muscles in 9.2 per cent, and hemorrhages or abscesses in the kidneys in 10 per cent. The lesions in the joints were distributed over the knees, the elbows and the shoulders, and often were found on both sides.

The streptococcus was proved to be present in the joints of fifty-nine (72 per cent) of the positive rabbits, whereas cultures from the other organs only rarely yielded this organism. The localizing power of the streptococcus was rather well retained through animal passage, in some instances the specificity increased, whereas in others it diminished.

AGGLUTINATION EXPERIMENTS WITH ARTHRITIS STRAINS

Streptococcus viridans from the tonsil of a patient with arthritis, and which was isolated from an infected joint of a rabbit that had been injected intravenously, was grown in large amounts of glucose-broth for eighteen hours, centrifuged, washed in sodium chlorid solution, and preserved in dense suspension in glycerin (two parts) and 25 per cent sodium chlorid solution (one part).

One series of four rabbits was immunized immediately, another after the strain had been preserved in glycerin for four months (Table III). The vaccine in each case was prepared by diluting the dense suspension with sodium chlorid solution to the density of glucose-broth culture and heating this at 60° C for thirty minutes. Each rabbit received 9 c.c. of the vaccine over a period of five weeks, receiving increasing doses on three successive days for each week as follows: 0.1, 0.2, and 0.3 c.c. the first week, 0.3, 0.4, and 0.5 c.c. the second week, and so on. The animals were bled one week after injection. The streptococci for agglutination, directly from the tonsils of patients with arthritis, from the joints of rabbits, and from the tonsils of normal persons, were grown in glucose-brain-broth for eighteen hours, centrifuged, and suspended in one-fifth the amount of sodium chlorid

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solution In many instances, a clumpy growth occurred in the broth, in others agglutination occurred promptly in the sodium chlorid solution suspension, and still others were agglutinated as markedly by the normal as by the immune serum All of these strains were discarded Twenty-nine cultures of streptococci from twenty-one persons were subjected to the agglutinating effect of the immune and normal rabbit serums Of these strains, seventeen were from patients with arthritis, and four from the tonsils of normal persons or from those suffering from conditions other than arthritis None of the four control strains were agglutinated markedly by the immune serum

In twenty-three of the twenty-five tests with the arthritis strains, agglutination was more marked and often occurred in much higher dilution in the immune than in the normal serum All of the strains that were agglutinated by the immune serum produced green or slightly hæmolytic colonies on blood-agar Agglutination was somewhat more marked and occurred in higher dilutions of the serum prepared with the freshly isolated strain than in that prepared after preservation in glycerin for three months

CONTROL EXPERIMENTS

In these two series of experiments, it was found that the strains obtained in cases of gastric ulcer and arthritis produced lesions in the organs of rabbits corresponding to those affected in the patients, also in other organs but in much lower percentage It was considered very important, therefore, to see what changes could be produced in the organs of rabbits by strains of streptococci from the tonsils of patients not suffering from any diseases resulting from focal infections For this purpose, I selected the tonsils of young persons who had their tonsils removed on account of recurring attacks of tonsillitis or on account of their large size The technic was the same as in the other experiments

Fifty-five strains were injected into 102 rabbits, and necropsy was performed on the third day after injection The percentage incidence of lesions in these experiments is given in Table II The lesions in the stomach consisted only of hemorrhages in the mucous membrane along the lesser curvature near the pylorus They were smaller and occurred less often than in the experiments with the ulcer strains

GENERAL DISCUSSION

Streptococci, usually in large numbers, were found in the tonsils constantly, those of the viridans group usually predominating in incidence and number

Dilated crypts, believed to be the result of fibrous adhesions, and filled with pus containing numerous streptococci and other bacteria, were found in the tonsils of many patients having ulcer of the stomach and arthritis The value of tall tubes of glucose-brain-broth which afford a gradient of oxygen pressure is illustrated by the fact that platings from eighteen-hour cultures in this medium often gave pure cultures of streptococci, whereas direct platings of pus from the tonsil yielded streptococci, staphylococci, *Micrococcus catarrhalis*, and other bacteria

The lesions in the stomach and joints not only occurred in a higher percentage of animals, as indicated in Table II, but also were more marked following the injection of the respective specific strains than following injection of non-specific strains In the case of the arthritis strains a larger number of joints were involved

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The findings in the ulcer experiments resembled those in the spontaneous disease in man. The animals with ulcer often appeared well, the location of the experimentally induced lesions and the number of organisms in the deep layers of the margins of the ulcers were similar to those in patients.

In many respects the findings in the arthritis experiments also resembled the arthritis noted in the patients. The joints most markedly attacked showed erosion of synovial and cartilaginous lining, there was usually extension to the periarticular structure, the streptococci in the free fluid were few or none. The large joints, both in animals and man subjected to the greatest stress and strain, were most frequently involved. Specific lesions developed only when small doses of the streptococcus from the pus expressed from tonsils *in situ* and from the small quantities of the broth culture, were injected.

The virulence of both the ulcer and the arthritis strains was low. Most of the animals apparently remained well after injection, and the blood and non-specific organs soon became sterile. Because of this and the marked stimulation of antibodies, healing began early. Frequently repeated onslaughts, such as we have reason to believe occur over long periods through chronic foci of infection, no doubt are often necessary for the development of chronic ulcer of the stomach and arthritis. The demonstration by Davis and Wood, of streptococci passing the epithelial lining of crypts in tonsils, and the fact that Rosenow and Meisser produced urinary calculi by devitalization and infection of the pulp cavity of teeth in dogs with streptococci from nephrolithiasis, no longer leaves any doubt that invasion from chronic foci occurs. The bacteria in the tonsils and other foci of infection and their toxic products are considered to be always in conflict with the defensive mechanism of the host. Fluctuations in virulence from exposure to cold or from other causes occur, peculiar invasive power may be acquired and for mechanical reasons afford abundant opportunity for entrance of the living bacteria and their products.

The characteristics of the streptococci isolated were variable. The organism was subject to the medium in which it existed and appeared in short or long chains, its fermentative power, while often persistent, was affected by the medium, the virulence varied, and the power of attacking certain tissues was often very labile on subculture and animal passage. As an example, a pure culture of hæmolytic streptococcus was obtained at necropsy from the blood of a person who was found to have had acute ulcer of the stomach and duodenum as a result of extensive burns of the third degree. The primary culture produced marked hemorrhage of the stomach in two rabbits injected, the fourth daily subculture in glucose-brain-broth, which was injected into three rabbits, produced hemorrhagic ulcer in only one, whereas the sixth subculture had no effect on the stomach in two rabbits injected.

My findings are in agreement with those of Rosenow with regard to the importance of foci of infection and elective localization of streptococci in arthritis and ulcer of the stomach, the lack of elective localizing power of

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control strains, the labile character of the property on which the elective localizing power depends, especially in cultures with a high oxygen tension, and the need for strict attention to technical details in elective localization studies

CONCLUSIONS

The tonsils of patients suffering from ulcer of the stomach and arthritis commonly harbor streptococci which tend to localize, respectively, in the mucous membrane of the stomach and in the joints of animals, and produce ulcer and arthritis in them which is not true of streptococci in the tonsils of normal persons. Hence, it may be concluded that foci of infection harboring streptococci having elective localizing power are important factors in the primary cause and the persistence of ulcer of the stomach and arthritis.

BIBLIOGRAPHY

- ¹ Billings, F. Focal Infection, Its Broader Application in the Etiology of General Disease. *Jour Am Med Assn*, 1914, vol lxiii, pp 899-903
- ² Billings, F. Chronic Focal Infections and Their Etiologic Relations to Arthritis and Nephritis. *Arch Int Med*, 1912, vol ix, pp 484-498
- ³ Billings, F. Chronic Infectious Endocarditis. *Arch Int Med*, 1909, vol iv, pp 409-431
- ⁴ Billings, F. Chronic Focal Infection as a Causative Factor in Chronic Arthritis. *Jour Am Med Assn*, 1913, vol lxi, pp 819-822
- ⁵ Davis, D. J. Experimental Study of Bacteria Isolated from Tonsils. *Jour Am Med Assn*, 1910, vol lv, pp 26-27
- ⁶ Irons, E. E., Brown, E. V. L., and Nadler, W. H. The Localization of Streptococci in the Eye. *Jour Infect Dis*, 1916, vol xviii, pp 315-334
- ⁷ Jackson, Leila. Experimental "Rheumatic Myocarditis". *Jour Infect Dis*, 1912, vol xi, pp 243-252
- ⁸ Jackson, Leila. Experimental Streptococcal Arthritis in Rabbits. *Jour Infect Dis*, 1913, vol xii, pp 364-385
- ⁹ Lillie, H. I., and Lyons, H. R. Tonsillectomy in Myositis and Arthritis. *Jour Am Med Assn*, 1919, vol lxxii, pp 1214-1216
- ¹⁰ Mayo, W. J. Recurrences of Ulcer of the Duodenum Following Operation. *Boston Med and Surg Jour*, 1914, vol clxx, pp 149-151
- ¹¹ Miyake, H. Beitrage zur Kenntnis der sogenannten Myositis infektiosa. *Mitt a d Grenzgeb d Med u Chir*, 1904, vol xiii, pp 155-198
- ¹² Rosenow, E. C. The Causation of Gastric and Duodenal Ulcer by Streptococci. *Jour Infect Dis*, 1916, vol xix, pp 333-362
- ¹³ Rosenow, E. C. Elective Localization of Streptococci. *Jour Am Med Assn*, 1915, vol lxxv, pp 1687-1691
- ¹⁴ Rosenow, E. C. Studies in Elective Localization. *Jour Dent Res*, 1919, vol i, pp 205-267
- ¹⁵ Rosenow, E. C. Iritis and Other Ocular Lesions on Intravenous Injection of Streptococci. *Jour Infect Dis*, 1915, vol xvii, pp 403-408
- ¹⁶ Rosenow, E. C., and Ashby, Winifred. Focal Infection and Elective Localization in the Etiology of Myositis. *Arch Int Med*, 1921, vol xxviii, pp 274-311
- ¹⁷ Rosenow, E. C., and Meisser, J. G. The Production of Urinary Calculi by the Devitalization and Infection of Teeth in Dogs with Streptococci from Cases of Nephrolithiasis. *Arch Int Med*, 1923, vol xxxi, pp 807-829
- ¹⁸ Wood, G. B. Tonsillar Infection. *Am Jour Med Sc*, 1914, vol cxlvii, pp 380-388

GUMMA OF THE BREAST, ITS DIFFERENTIAL DIAGNOSIS FROM CARCINOMA*

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IN MANY instances the accurate diagnosis of breast conditions is most difficult. This is due chiefly to three causes:

I. The numerous manifestations of the normal breast, or the near normal breast, such as a thin breast, a fat breast, a pregnant breast, an involution breast following pregnancy, etc.

II. The varying phases of the normal breast due to the person's *age*, such as a breast of puberty or the atrophy and involution of the breast past the climacteric.

III. The multiple and widely varying forms taken by each of the well known diseases of the breast, such as carcinoma, fibro-adenoma, chronic mastitis, cysts, traumatic fat necrosis,¹ etc.

Other reasons for difficulty in breast diagnosis lie in the lack of help afforded by the anamnesis. The history of any given breast condition is less pathognomonic and less helpful for working out an exact differential pathological diagnosis than the history which goes with a duodenal ulcer or a gall-bladder disease. One must take the aid supplied by the available history, but he must chiefly rely upon our sense of careful scrutiny, and a sense of delicate touch.

In this paper the author will not attempt to differentiate gumma of the breast from the normal variations of the organ, nor from the changes due to the age of the patient, nor from the majority of the well known diseases of the breast. But since it is a common error to mistake gumma for carcinoma, our attempt will be to emphasize a number of points in diagnosis which will place gumma of the breast in a clean-cut category of disease so that more gummata will be recognized, fewer will be operated upon, and more patients will retain their breasts.

Vichow in 1861 said "concerning syphilitic tumors of the breast we know very little", he states that he welcomed an opportunity to study one.

Lancereaux declared that "any one who had not observed the commencement of this affliction and did not know the antecedents of the patient, would be unable to distinguish this tumor from that known under the name of scirrhus of the lactiferous ducts."

Edward Martin² says "The diagnosis from cancer may be quite impossible except from a consideration of the associated symptoms and the result of the therapeutic treatment."

* Read before the Clinical Research Society of New York City, January 31, 1923

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Even those surgeons who see an extraordinarily large number of breast cases, have rarely seen a gumma of the breast. In fact the *rarity* of the condition is where the responsibility lies for its non-recognition, because it

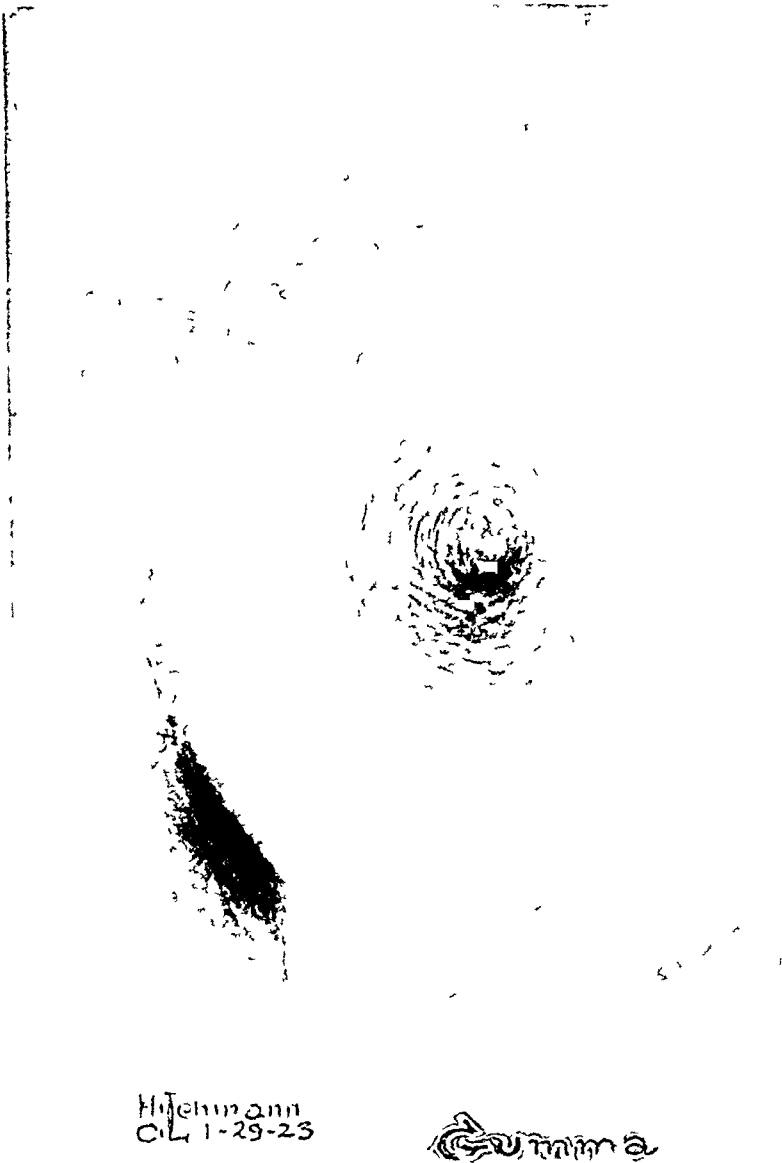


FIG 1—Gumma of breast

has sufficient in the way of history, appearances and characteristic attributes, to definitely be diagnosed before coming to the operating table

In the Breast Clinic of the Memorial Hospital conducted by Dr B J Lee and the author, we see large numbers of breast cases with malignant and non-malignant conditions. But this is the only case of gumma which we have had during the period in which 1674 cases of carcinoma have been observed. It

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is therefore obvious that gumma is a rare breast tumor. The following is the case report of a patient who came to Memorial Hospital August 14, 1922

R. G. age thirty-five, female married. Due to the fact that she spoke a Hungarian dialect only a poor history could be elicited. In brief it is as follows:

Family History—Negative

Personal History—One year ago she had an operation at Mt. Sinai Hospital for "red spots" over the outer part of right shoulder. Otherwise history is negative. At a later date through an interpreter the following supplementary history was obtained, but not until some time after her operation. It would have been an aid to diagnosis had we obtained it before our operation. The patient had one miscarriage during her first year of married life. Husband had had syphilis four years before his marriage. He had had no treatment. Otherwise the history is negative.

Mammary History—About five months ago the patient noticed a lump (Fig. 1) in the lower inner portion of the right breast situated at the fold of breast with chest wall. This has increased considerably in size in past three weeks and has recently begun to give slight discomfort. No treatment has been given except application of salves locally. There is no history of trauma.

Physical Examination—Patient is a middle-aged woman with rather a pasty complexion.

Head—Eyes react to light and accommodation.

Nose—Negative except for a slight scar and redness of the skin of the nasal septum.

Mouth—Teeth Poor. Marked pyorrhea. No leucoplakia.

The outer aspect of right shoulder shows an irregular scar of a former operation (Fig. 2).

Chest—Heart. Sounds are normal. Not dilated. *Lungs*—There are occasional sibilant sonorous rales over lungs posteriorly, especially on right side.

Abdomen—Negative. *Lymph-nodes*—There is slight enlargement of the entire system but it is not marked.

Surgical Condition—There is a tumor of the right breast situated at the fold of breast with chest wall. It appears about the size of a hen's egg bisected on its long axis, tumor is dome-shaped. It has a reddish-bronze color and is very hard in consistence, smooth over its surface, fairly sharply circumscribed, seems to be part of and attached to the skin, measures about 6 by 4.5 cm. and is elevated from the chest wall about 2.5 cm. at its peak. The tumor is movable on the chest wall and has no deep attachment. It is not tender to palpation. There is no nipple retraction, and no orange-peel skin appearance. Remainder of the breast is negative. Left breast is negative. The nodes in both axilla are palpable but not sufficiently enlarged or hard to make a diagnosis of carcinomatous involvement certain. However, mental reservation was made on this point. There was one node in the left supraclavicular region which is hard and markedly enlarged.

The above physical examination was made by our admitting physicians who felt it was carcinoma of the breast, and they sent it to me for operation. The patient did not return for operation until ten days later. When she came the picture had changed in two respects, namely, there was a slight elevation of temperature of the tumor itself, and also a suggestion of fluctuation at the apex of the tumor. At the periphery it was very hard. In fact most of the tumor had the stony hardness of carcinoma. The skin had become deeper bronze color. My feeling was that this was some unusual form of infection. So instead of doing the radical breast amputation for carcinoma, an incision was made directly into the tumor. There exuded about 30 c.c. of dirty looking, liquified necrotic tissue, which did not simulate pus. A section was removed for microscopic study, from the

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thick indurated wall The part of the tumor which was not necrotic was hard and appeared very cellular and œdematous, it simulated sarcoma tissue The diagnosis was still uncertain so the cavity was packed Further procedure was



FIG 2 —Showing sear of former operation on right shoulder

to be guided by the microscopic report Later the pathological report came that the tissue showed an infective process, with no evidence of neoplasm The subsequent course of this case was, that the wide open wound drained profusely for about a month The bottom of the wound became red, thick, and dirty, necrotic material The sharp edges of the wound became typical of a syphilitic ulcer clean-cut overhanging the excavated cavity It was typical of a syphilitic process This condition persisted with not the slightest attempt at any reparative process On two occasions, the slides were reviewed with a pathologist to ascertain his

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impression as to whether or not it might be a tubercular process. It was at this juncture that we secured the interpreter who gave us the history of the syphilitic infection of the husband, and the miscarriage in the patient. Blood was taken for a Wassermann test, and it was reported four plus.

The slide was reviewed by Dr. James Lwing whose report follows: "The specimen consists of fat tissue very thickly infiltrated with lymphocytes and

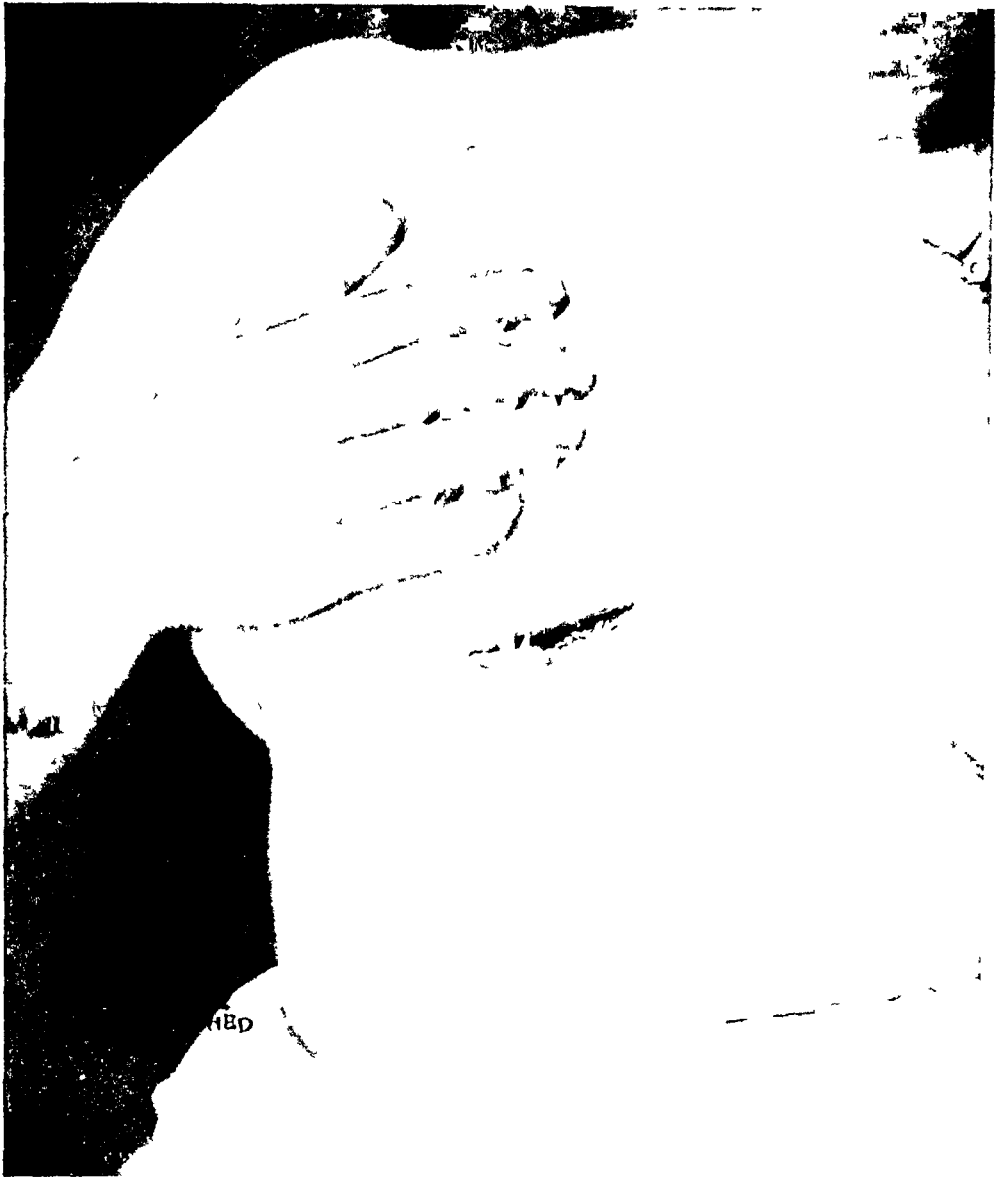


FIG. 3 —Showing wound of operation healing under the influence of salvarsan internally.

plasma cells. Some large arteries show lymphoid infiltration of the adventitia. There is no necrosis. Polymorphonuclear leucocytes are very abundant throughout. The lesion may be interpreted as a gumma."

I asked Dr. F. F. Mandlebaum, Pathologist to the Mt. Sinai Hospital, to review his sections of the tissue ("red spots") removed from the right shoulder, May 22, 1921, when the patient was operated in that institution. His report is: "Although the essential lesion is that of a purulent inflammation, there are some

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vascular changes, which, in view of the further development in the case, may be interpreted as due to syphilis "

An X-ray plate was made of the ribs to see if this gumma might have some connection Doctor Herendeen reported it "negative for bone involvement"

The patient was given seven doses of salvarsan which by January 15, 1923 entirely healed the gumma—four and one-half months after the patient was first seen

Figure 3 shows the process when five doses of salvarsan had been given, a short time before the wound healed

One will usually find some other evidence of a tertiary lesion associated with a breast gumma, in this case it is the nasal septum and the skin lesion (Fig 2)

The natural history of gumma of the breast is more readily comprehended if divided into the following six periods

First Period A lump appears which is painless, smoothly surfaced, very hard, shapely circumscribed, freely movable in the breast There is no nipple retraction unless the tumor lies in close proximity to the nipple

Second Period The tumor usually grows outward It begins to involve the subcutaneous tissues There may or may not be "orange-peel" appearance The overlying skin becomes attached to the tumor

Third Period The tumor in its growth pushes outward the overlying skin, and the skin becomes incorporated as a part of the tumor The skin takes on a bluish tint

Fourth Period The tumor has increased in size, the skin has become purple or bronze due to the pressure and the stagnant blood supply The centre of the tumor softens, and later becomes fluctuant As it softens it becomes slightly tender It now has a dome contour, and is shaped like a hen's egg bisected along the long axis

Fifth Period Due to pressure necrosis, the skin becomes so thin and unhealthy that the gumma perforates and the necrotic material drains out

Sixth Period After evacuation of the contents, a typical, crater-like, dirty, gray, sloughing, foul, deep syphilitic ulcer remains This stage will remain until the patient receives anti-luetic treatment

The great importance of this tumor lies in the fact that during the first three or four periods above described, it so simulates carcinoma of the breast, that it is most difficult to distinguish, and only with the most minute consideration will it be possible to do so before the tumor has reached the Fourth Period After this stage the diagnosis is more simple

The fact that a patient has had syphilis must not have too strong a bearing against the diagnosis of carcinoma, for we occasionally see a carcinoma in a luetic subject Incidentally this group fare much worse than when carcinoma of the breast is not on luetic soil

There are points which gumma and certain types of carcinoma have in common namely, (1) stony hardness, (2) sharp circumscription, (3) painlessness, (4) skin involvement

There are some characteristics of gumma usually not found with carcinoma These are of diagnostic aid (1) history of syphilitic infection,

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miscarriage, etc., (2) presence of other syphilitic manifestations, (3) bizarre involvement of the lymph-nodes, (4) tumor egg-shaped, (5) rarely orange-peel skin appearance, (6) gumma grows faster than carcinoma, (7) nipple never retracts unless lesion lies very near it, (8) fluctuation is the rule at one stage, (9) tenderness at this stage, (10) at later stage of ulceration the axillary nodes become markedly involved, (11) Wassermann test positive, (12) therapeutic test with salvarsan.

In carcinoma, the regional lymph-nodes do not become involved in any bizarre or irregular fashion, but they follow the definite rule that on the side of the lesion, the axillary and low-lying cervical "signal" nodes are involved first. Also in carcinoma, nipple retraction or a nipple slightly "stuck" is one of the *very early* signs—this point cannot be over emphasized.

In the following analysis of the 45 case reports previously recorded, one notes that the first report was 155 years ago, by Sauvages in 1768. It is interesting that it was a hundred years later before the disease became sufficiently recognized to merit a place in the text-books on breast diseases. Gromo's¹⁴ thesis was an impetus because he was the first to collect the case reports. It seems strange that in searching the literature, one finds but 45 cases recorded. A study of these cases is unsatisfactory because of lack of information on which to base a diagnosis. One is struck with the confusion of gumma with carcinoma. Such terms as "pseudo-scirrhous" and others equally vague, are common. Pathologic fractures are recorded. Some "died from the disease." In New York one case was shown before a Dermatological Society¹⁵ as a case of Paget's Disease, the same case later was presented as a gumma. The case of Patterson¹⁶ in England is interesting. His case was confused with malignant disease. He made an ante-operative diagnosis of carcinoma, he performed a radical breast amputation before a surgical society. On gross section it appeared to be sarcoma. He brought out the point that grossly the fibrous tissue of this tumor so simulated sarcoma that he wondered how to avoid making a similar mistake in diagnosis.

Age Incidence—There are 33 cases recording the age of the patient, eight cases reporting no age. There is one case in a congenital luetic child, two, in "old woman", one in "middle age", and one, in "young lady." According to decades

1 to 10 years	— 1 congenital child
10 to 20 years	— 2 cases
20 to 30 years	— 6 cases
30 to 40 years	— 10 cases
40 to 50 years	— 8 cases
50 to 60 years	— 6 cases
62 years	— 1 case

Sex Incidence—Of the 35 cases recording sex, it was 3 times present in men and 32 times in women.

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Pain—One of the chief diagnostic points is painlessness at first. It is only in the later stages of tumor softening that pain is present. Thirteen of the tumors were painless, two of these 13 *while under observation* became painful. Five tumors were painful. The tumor is not tender to touch. It is tender only after fluctuation has appeared.

Movability. The tumor is usually movable in breast tissue. In those cases where the point is discussed 8 cases were freely movable and only one had deep attachment.

Rate of Growth—The tumor develops rapidly in comparison to most breast tumors and goes on to quick ulceration. In Lapowski's case²¹ the tumor grew in three months, in Bruc's case²² the growth was "rapid", in the author's case it took five months.

Skin Attachment—Little aid is given on analysis of this point. Of 14 case reports mentioning this, 5 have no skin attachment, 6 have definite attachment, and 3 have tumor fusion with the skin. This point depends on the period of the disease. Early there is no attachment, late there is fusion.

Nipple Retraction—In the eight reports mentioning this, 5 had definite retraction and 3 did not. But where so large a proportion of the 45 cases do not mention it probably there was no retraction. Nipple retraction will occur only when the gumma lies in close proximity to the nipple.

Axillary Node Involvement—In the 21 case reports mentioning this, 12 cases had no palpable involvement. Nine cases had definite enlarged nodes in the axilla of the side of the breast lesion. One states that the axillary mass of nodes is the size of an egg. Axillary node enlargement comes particularly at the time of ulceration but is not to be expected before this stage. Delbert²³ states there are no axillary nodes and gives this as an important differentiating point.

Supraclavicular Node Involvement—Six cases had supraclavicular involvement, and six cases had the supraclavicular group combined with other lymphatic manifestations. There is great irregularity as to which supraclavicular nodes become involved.

Breast Involvement—(a) One breast only was involved in 19 cases in which this was mentioned. The probabilities are that the 18 cases in which this point was not mentioned had but one breast involved.

(b) Eight cases had gummata of both breasts.

(c) Seven cases had more than one gumma in the same breast.

(d) In one, the gumma lay between the breasts.

Wassermann Test—In only three of the 46 cases was the test made. They were all positive. It is interesting to note in 1912 in the case of Yvert²⁴ which he had in the rural districts of France that "a Wassermann was considered but not made because it cost too much for the test."

Microscopic Examination—Aside from the case of the author, it has been made in only two previous cases. Had it been more frequently made we would have found more cancer cases in this series, and fewer gummata.

Reported by year	Patient's age	Male	Female	Syphilitic one tumor	Wassermann rep ^l before definitely
Neumann ¹⁹ , 1889	27		+	—	
Malfeso ²⁰ , 1890		Record of c.			
Ostermayer ²¹ , 1893	26		+	+	rese the
Ostermayer ²¹ , 1893	50		+	—	
Emery ²² , 1896	30		+	+	radical surgery
Legrain ²³ , 1897	50		+	0	
Kennedy ²⁴ , 1902	30		+	+	authen- taneous n to see d cases
Heller ²⁵ , 1903	62		+	-	
Heller ²⁵ , 1903	?			—	entiation
Bruc ²⁶ , 1903	56		+	+	Report on arcinoma
Beer ²⁷ , 1905	35		+)	
Bissel ²⁸ , 1907	32			—	
Bissel ²⁸ , 1907	48		+	+	
Bissel ²⁸ , 1907	"Middle age"			—	rdi, 1854 ournal de
Bissel ²⁸ , 1907	39			+	
Bissel ²⁸ , 1907	35			—	
Lapowski ²⁹ , 1908	56		+	+	
Patterson ³⁰ , 1909	26		+		
Yvert ³¹ , 1912	46		+		"Not d cost t ^{tc} Med much
Yvert ³¹ , 1912	?				
Chevannez and Loubet ³² , 1913	"Young lady"		+		+ vien med
Thompson ³³ , 1920	33		+		+ p 375 stdrusse"
Adair, 1923	35		+	+0	+ vii p 36

<i>P_i</i> in the tumor ful tender <i>M</i> where deep a <i>Ra</i> breast tumor author <i>Sk</i> case re ment period <i>Nip</i> retract not me occur on <i>Avil</i> cases ha the vill nodes is the time states th ferentiat <i>Sup</i> ment, an lymphatic cular nod <i>Bicas</i> which thi this point (b) 2— (c) (d) 1 ^{one,} _{too} <i>Wassel</i> They were which he sidered bu <i>Micros</i> made in on have found	Microscopic report	Diagnosis	Surgical treatment	Anti-luetic treatment	Remarks
				+	Cured
	O	Scirrhus cancer	+	+	Due to bad heart condition, operation at first not done, antiluetic treatment Later operation because so large
	+	Cancer Cancer			Patient refused operation
		Others—cancer, beer, syphilis		+	Cured in one month
		Sent for cancer operation			Indurated growth
		"Paget's disease" (cancer)		+	Shown first before society as a Paget's disease Later treated by drugs
		Cancer	+		On section looked like sarcoma Radical operation Two weeks later ulcerated and knew it was syphilis
		Cancer			
		Cancer			
				+	Cured
				+	
	Gumma +	1 Cancer 2 Infection	Simple incision +	Later +	Sent for radical operation for cancer Incised on diagnosis of infection Wound would not heal Anti-luetic treatment, cured

Primary Diagnosis One of the most striking points of the analysis is, 15 cases in which diagnosis was made before operation, or before it became self evident by the progress, 14 cases were definitely cancer, and only one case as a non-malignant condition

Result (a) In 20 cases anti-luetic treatment was given, of these the 13 were cured

In eight cases surgical treatment was resorted to, some had a radical operation of the breast and axillary contents. Some had less radical surgery. Some refused surgical aid

One patient died and an autopsy was made. Billroth doubted the authenticity of being a gumma. In another case, the patient got a spontaneous cure and died. In these last two cases it requires little imagination to see the difference between gumma and carcinoma in this series of reported cases of analysis of 46 cases.)

BIBLIOGRAPHY

W. J. Caird Traumatic Fat Necrosis of the Female Breast and Its Differentiation from Carcinoma. ANNALS OF SURGERY, August, 1920, p. 189. A Further Report on Traumatic Fat Necrosis of the Female Breast and its Differentiation from Carcinoma. ANNALS OF SURGERY, April, 1922, p. 521.

Nostologia Methodica, 1768, T. IV, p. 344.

Abhandlung von dem wahren Krebschaden. Gottingen, 1775.

Maladies du sein—Valpeau 2^e edition, 1849, p. 535.

Metamorphoses de la syphilis, 1854, p. 435.

Bulletin de la Societe anatomique, 1855, 30^e annee, p. 97.

Di una malattia della ghianda mammae. Gazzetta Medica Italiana, Lombardi, 1854.
Revue sur un cas de tumeur syphilitique simulant un cancer du sein. Journal de Medicine de Lyon, 1867, vol. VII, p. 23.

Keen's Surgery, vol. I, p. 715.

Archiv für Gynaekologie, 1870, II, Band, p. 71.

Les tumeurs du sein chez l'homme. These de d'agregation, 1872.

These de Paris, 1874.

Erfahrungen über Syphilis. Stuttgart, 1875, p. 165.

These de Gromo, 1878.

Boston Med. and Surg. Jour., vol. C, 1879, No. 12.

Med. Wochenschr., 1880.

Syphilitic Mammary Disease. Report of a Case of Inherited Syphilis, etc. Med. Record, 1883, vol. XXIV, p. 91.

Archow. Hirsch, 1888.

Über die syphilitische Erkrankung der Brustdrüse. Allg. Wien. med. Wochenschr., 1889, vol. XXXIV, p. 593.

Un caso di mastite gummosa. Progresso Medico Napoli, 1890, vol. IV, p. 375.

Dr. "Ein Fall von Gummoser Erkrankung der Weiblichen Brustdrüse."

Dermat. und Syph. Wien und Leipzig, 1893, vol. XXV, p. 940.

Homme du sein. Bull. soc. franc. de dermat. et syph. Paris, 1896, vol. VII, p. 36.

FRANK E ADAIR

- ²⁰ Legram Mastite syphilitique gommeuse Ann de dermat et syph, Par, 1897, 3 S, vol viii, p 500
- ²¹ Kennedy Case of Gumma of the Mamma Tr Med Chir Soc Glasg, 1902, vol iii, p 71
- ²² Heller Munchener med Woch, 1903, vol 1, 738
- ²³ Bruc Mastite gommeuse du sein gauche Montpel Med, 1903, vol xvi, p 244
- ²⁴ Beer Medical News, N Y, 1905, vol lxxxvii, p 825
- ²⁵ Bissel Syphilitic Tumors of Breast Medical Record, N Y, 1907, vol lxxvii, p 14
- ²⁶ Lapowski Jour Cut Diseases, N Y 1908, vol xxvi, p 372
- ²⁷ Patterson Gumma of the Breast Simulating Malignant Disease Proc Royal Society of Med London, 1909, vol iii, p 82
- ²⁸ Yvert Les tumeurs syphilitiques du sein Poitu med, Poitiers, 1912, vol xxxiii, p 179
- ²⁹ Chevannez et Loubet Gomme syphilitique du sein Jour de med de Bordeaux, 1913, vol xliii, p 482
- ³⁰ Thompson Gumma of the Breast J A M A 1920 vol lxxiv, p 791
- ³¹ Gromo Syphilis Hereditaire et tertiaire These de Paris, 1878
- ³² Delbet Duplay et Reclus Traite de Chirurgie, vol v p 857

THE LIVER AND ITS RELATION TO CHRONIC ABDOMINAL INFECTION*

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THE liver, probably the most important organ in the body excepting the brain, has long remained an enigma of clinical pathology and symptomatology. It has been habitually associated in the minds of the laity with "biliousness" and torpid liver, and the various cholagogues and remedies for supposed hepatic insufficiency are legion.

Pathologists have been endeavoring to explain the origin of a variety of liver changes that accompany or are terminal to widespread or local disease within the abdomen. This association has been so commonly observed and the relationship exhibited so casual that it has not aroused the interest that it ordinarily should have. The clinician has become acquainted, both clinically and pathologically, with a variety of hepatopathies, and has subdivided the diseases of the liver, excluding the acute affections, into those in which fibrous tissue elements were found about the periportal veins and typified by Laennec's cirrhosis and those in which fibrous tissue elements were found about the bile radicles with biliary stasis and typified by Hanot's cirrhosis. Midway between these two extremes have been classified a variety of affections with indistinct symptomatology and unclassified pathologic findings.

Since 1910, the writer has been particularly interested in a series of gall-bladder cases that have exhibited unusual and peculiar post-operative complications. The complications that may reasonably be expected after laparotomy for gall-bladder disease are clearcut and distinct and possess within certain limits a chronological sequence. In the first twenty-four hours the complications are anatomical, such as hemorrhage, shock, gastric dilatation and embolism. In the succeeding forty-eight to seventy-two hours the element of infection might possibly come into play, with the production of a peritonitis and still later, abscess formation. We have observed occasionally three clinical states that supervene after operations on the gall-bladder and biliary system, and more rarely after gastric or intestinal surgery, and which cannot be attributed to any of these factors. Although these clinical complications are comparatively rare, yet they are definite and apparently within their group, are rather characteristic in their symptomatology. For convenience of description we have classified them into three more or less distinct groups. The first group is represented by patients who have had comparatively simple gall-bladder operations. As a rule the surgery has been confined entirely to the gall-bladder and the removal of the appendix. The patients are always obese and have a history of chronic gall-bladder disease extending

* Read before the New York Surgical Society, New York, October 24, 1923

over a long period of time. Preliminary study of the urine and blood has assured us as to the competency of renal function. They have been anesthetized with gas and ether and a cholecystectomy and appendectomy performed. Following the operation the recovery from the anesthesia is delayed, in fact, it may be said that they never completely emerge from their anesthesia. They remain, for four to six hours after being returned to the ward in a semi-comatose condition. They develop talking delirium, carphology, subsultus tendinum, which finally passes on into coma, with death. In view of the fact that the post-operative clinical syndrome suggested a distinct mental irritation spinal punctures have been made with comparatively negative findings. The cell count has been ten or eleven cells per cu mm, globulin, one plus, Wassermann, negative. Preliminary studies seemed to suggest that there was no renal element in these cases although coincident with the development of the delirium there is gradual diminished urinary output both in fluid quantity and in chemical elements. We were in the habit of attributing this condition to the development of a post-operative acidosis incident to the poor metabolism represented by chronic biliary disease plus the additional elements of anesthesia and surgical trauma. In making a complete study of these patients both before and after operation Doctor Killian was able to show that the carbon dioxide combining power of these patients was far in excess of the normal and approached values of 70 to 80, and occasionally to 90 volumes per cent, and that the condition chemically is that of an alkalosis. In none of these patients in this group had there been a preliminary administration of alkalis, and we can reasonably exclude the suggestion of sodium poisoning. In the last two years in the collective service of the attending surgeons at the New York Post-Graduate Medical School and Hospital, we have been able to study six of these cases four of which terminated fatally.

The second group is essentially different in its clinical manifestations. These patients, as a rule have had a very severe type of biliary infection and there has been a history of jaundice and a previous gall-bladder operation. The patients have had a choledochotomy with drainage of the common duct and the post-operative progress has been satisfactory until about the end of thirty-six to forty-eight hours, when they become irritable and nervous. Within a very short time the patient passes into a pronounced vasomotor collapse with cold, clammy, "leaky" extremities. The condition is not associated with gastric dilatation and there has been ample renal function. The intravenous administration of glucose and saline and continuous Murphy proctoclysis with tap water has usually brought about a recovery. We have considered these cases as due to the liberation of some pancreatic toxin with inadequate liver protection. These cases do not exhibit the alkalinization of the preceding group and their blood chemistry is only changed in so far as there is a change in the percentage of the rest nitrogen to urea nitrogen. The third group presents a still more difficult phenomenon in that the lethal complication occurs in patients who were apparently progressing favorably

up to the end of five or six days after operation. They were all patients with a clinical picture of calculous cholangitis, pancreatitis or rarely, malignancy of the head of the pancreas. At the time of operation their blood chemistry had been studied and the coagulation time, if necessary, had been brought within normal range by blood transfusion or the intravenous administration of ten per cent calcium lactate. The operation had been undertaken for the relief of the pathologic condition of the gall-bladder and common duct or to institute biliary drainage either externally through the anterior abdominal wall or by the anastomotic union of gall-bladder to stomach. The immediate post-operative condition had been satisfactory. The icterus had begun to diminish appreciably in intensity and the dehydrated condition had been manifestly overcome by continuous Murphy proctoclysis of ten per cent glucose. These patients had been fed their own bile where there was external drainage, either by swallowing, or by means of a stomach tube, so that it was reasonable to suppose that the lack of bile salts was not an element in their condition. The maintenance of normal bile salt content is essential because Cokeman has shown that the salts in the bile gradually diminish with external drainage to approximately one-tenth of the normal quantity. This mechanism would seem to suggest a conservative action upon the part of the organism to conserve the totality of bile salts present in the body. At the end of five or six days, occasionally ten days with a constantly diminishing jaundice, these patients become somnolent, sleepy, and pass into a pronounced state of coma and die, irrespective of any remedial agents employed. The clinical picture presented is essentially a coma, occurring in a patient with a diminishing obstructive jaundice. In its manifestations it is not unlike the terminal stage of a portal cirrhosis with complete liver exhaustion. Some of these cases at operation showed "white bile," both in the gall-bladder and in the common duct. We have not regarded the presence of white bile as contributing to this condition, except in so far as it tended to indicate an increase in the immediate operative mortality. We have taken the explanation of Kausch that white bile represents a purely mucosal secretion and by and of itself has no deleterious qualities.

We have long felt that these three clinical conditions were in some way connected with an impaired liver function, either a disturbed liver metabolism, a liver dysfunction or a liver insufficiency. In the first type the rapidity with which the development of coma is brought about takes it entirely out of the infectious class, and while it is possible that the operation may have liberated certain deleterious products, the whole mechanism suggests a complete and rapid cessation of liver function. The second type of complication occurs too late for primary operative shock, and occurring as it does, in patients who have had a previous gall-bladder operation with palpatory injury to the pancreas, might be possibly interpreted as due to toxic inundation of the system and direct poisoning of the liver cells with cessation of function. In the third group there must be considered the possibility of an infection. The operation itself has been conducted in an infected field and various

encapsulated bacteria have been liberated, so that the mortality in this group might be explained by an increasing bacterial infection, yet clinically there is no evidence of it. We have unfortunately not controlled these cases with repeated blood cultures a line of investigation we propose to pursue, but it seems more probable that these patients have had sufficient liver function to maintain a certain degree of bodily welfare and activity. When this is interrupted by a surgical operation or there is thrown upon an already compromised liver the increased burden of detoxifying a further increment of deleterious products, the liver is unable to do so and the interim between operation and death represents the period of increasing and progressive exhaustion of liver capacity. The liver is notoriously able to handle infections and catabolic proteins that are the result of infection. If the dosage of these offending bodies is so great as to overwhelm the liver or their toxicity is beyond the detoxifying power of the liver, it is a question only of time before the liver fails to give that protection which, under ordinary circumstances and even in the presence of a chronic abdominal condition, it has been competent to do up to this time.

During the course of these observations we were stimulated by the very splendid clinical report of Stockton, who was able to report in detail a progressive infection of the entire gastro-intestinal canal later of the liver, and finally death with post-mortem findings showing marked degeneration in the liver. From the clinical and pathological point of view, Graham has clearly demonstrated the frequent association of disease of the gall-bladder with the pathological evidence of hepatitis.

Experimentally it has been possible to produce hepatitis by partial ligation of the common duct, and it is interesting to note that tropical abscess is almost invariably associated with the right side of the liver, the splenomegalias and gastric affections with the left side of the liver while diabetes when it is associated with liver pathology almost invariably exhibits the hepatic change in the right lobe. Reidel drew attention to the fact that the lobe of liver, which goes by his name, is confined to the right side, and Glenard states that Reidel's lobe was the direct result of inflammatory changes incident to gall-bladder disease. Hess and Serege attempted to segregate certain functions of the liver as being peculiar to either the right or left lobe. Glenard intimated that there was a difference in function between the right and left lobe and the injection of staining fluid into various branches of the portal system was followed by unequal distribution throughout the liver, that from the superior mesenteric vein showing a predilection for right-sided distribution and that from the splenic vein, predilection for the left side of the liver.

In the liver we have a complete biochemic laboratory, approximating a weight of fifty ounces and a variation of ten per cent over or under might be indicative of an hypertrophy or an atrophy. Enlargements of the liver clinically are extremely difficult to determine, as we have no accurate means during the course of laparotomies to estimate the size or weight of the organ and the determination of enlargement is predicated by the personal equation

of the operator. Again, there must be other biological factors in that some people are born with good livers and are able to withstand a degree of trauma that cannot be withstood by other individuals. The liver stands midway between the portal and systemic circulation and is interposed between the spleen and the heart. It receives the blood from practically the entire viscera of the abdomen, yet the amount of arterial blood given to the liver is extremely little, as the final divisions of the hepatic artery that go to the liver are extremely small in relation to the bulk of the gland. It has never been distinctly proven that there are arterial vessels that nourish the individual liver cells. The arterial branches apparently terminate in the interlobular connective tissue. The bulk of the blood that traverses the liver is venous, one-sixth to one-eighth of which represents splenic blood. This venous blood contains the byproducts of splenic bacteriolysis together with all of the food elements in varying amounts. The latter are to be translated into energy values by the action of the liver. The vital functions of the liver are carried on with practically only venous blood.

Preeminently the liver is concerned with the storage of glycogen, biologically probably the oldest established function of the liver. (2) It is intimately concerned with the metabolism of proteins, either simple or compound. (3) It exerts some ancillary function in connection with the metabolism of fats. (4) It has a pronounced influence on the coagulation of blood and with the development of fibrinogen. (5) It carries on bile formation and bile secretion. (6) It constantly exhibits a marked depurative or detoxifying function. In this connection it is interesting to consider another phenomenon of the liver, in that it has the most remarkable regenerative capacity of any organ in the body. When an organ is called upon to respond to additional work, it hypertrophies, and we have the common phenomenon of compensatory work hypertrophy. The liver, on the other hand, participates in no hypertrophy but shows a regenerative capacity of the highest degree.

Mann has been able to remove seventy per cent of the liver and in a very short space of time—eight weeks—found complete regeneration of the organ. In addition, he has been able to ligate seventy per cent of the bile ducts producing an atrophy with complete regeneration on the other side, and Rous and McMaster have ligated nine-tenths of the bile vessels without producing bile stasis or icterus. A very interesting paper by Pool and Bancroft drew attention to nodular hyperplasia, occurring in the midst of a completely atrophied and degenerative liver, the hepatic regeneration in their cases standing forth as hyperplastic islands of newly formed liver tissue. The individual liver cell is of the simplest type and it contacts on one side with the bile channel and on the other with the venous channels. It is susceptible to injury by any offending agent—biochemic or chemic, that may be brought to it and irrespective as to the character of the offending agent, manifests its intrinsic cell reaction by fibrosis on the one hand, with an almost equal amount of regeneration on the other hand. One has only to recall the innumerable cases of patients who have had a laparotomy and

the surgeon has found marked cirrhosis without any clinical evidence of the condition being apparent, due to the maintenance of hepatic function by active liver regeneration.

It would seem that a small area of liver tissue is quite capable of carrying on the normal functions of the body. The question that naturally presents itself for consideration is: What is the effect of long continued infection in the abdomen in regard to changes in the liver? The association of gall-bladder disease with histologic evidence of liver degeneration is conclusively proven. In every one of Graham's operative case with demonstrable pathology in the external biliary system there were the macroscopic and microscopic evidence of liver change. He was able to obtain on culture from the liver tissue the same bacteria dominant in the diseased gall bladder. In the sub-acute and acute cases the liver was enlarged in sixty-seven per cent. of his cases, the edge edematous and the changes more pyemic than in the more chronic cases. Can we go further and demonstrate a hepatitis, either sequential to or concomitant with chronic abdominal infection in regions remote from the gall-bladder? About eighteen months ago at the Post-graduate Hospital with the assistance of Doctor McNeal, Pathologist, and Doctor Kilham, Biochemist, we undertook a threefold study: (1) A critical study of all of the organs exposed during the course of all laparotomies irrespective of the original abdominal condition. (2) The removal of a portion of the liver from both the right and left lobes wherever mechanically possible and (3) a pre-operative and post-operative study of the blood in relation to the known elements of blood chemistry. We have assumed that a partially obliterated appendix or a completely obliterated appendix, represented the indubitable proof of an inflammation and that in this condition at least there must be continuous seepage of infective material or chemical byproducts into the portal system and which being carried to the liver would manifest themselves in the histologic evidence of inflammation about the periportal system or the bile ducts. In this we were not mistaken as is evidenced by the cases herein reported. We pursued the same line of investigation in regard to carcinoma of the stomach and again in ulcer of the stomach and likewise repeated the work of Graham on the relationship between manifest disease of the biliary apparatus and histologic changes in the liver.

While investigating this subject we would remove two or three small pieces of liver during the course of an operation. The first section removed was usually from the neighborhood of, or adjacent to the gall-bladder the second piece from the superior surface of the right lobe and about five cm. distant from the gall-bladder and less frequently from the superior surface or anterior border of the left lobe, depending upon the accessibility of this portion of the liver. It may be stated that when we found macroscopic liver changes present, the pathologic changes were uniformly distributed throughout the right lobe of the liver and at the same time there was always evidence of the same pathologic process in the left lobe but ordinarily of less intensity than in the right lobe. It occasionally happened that the liver changes were

much more marked than the associated pathology in the gall-bladder, appendix or stomach. In other words, the changes in the abdominal viscera were

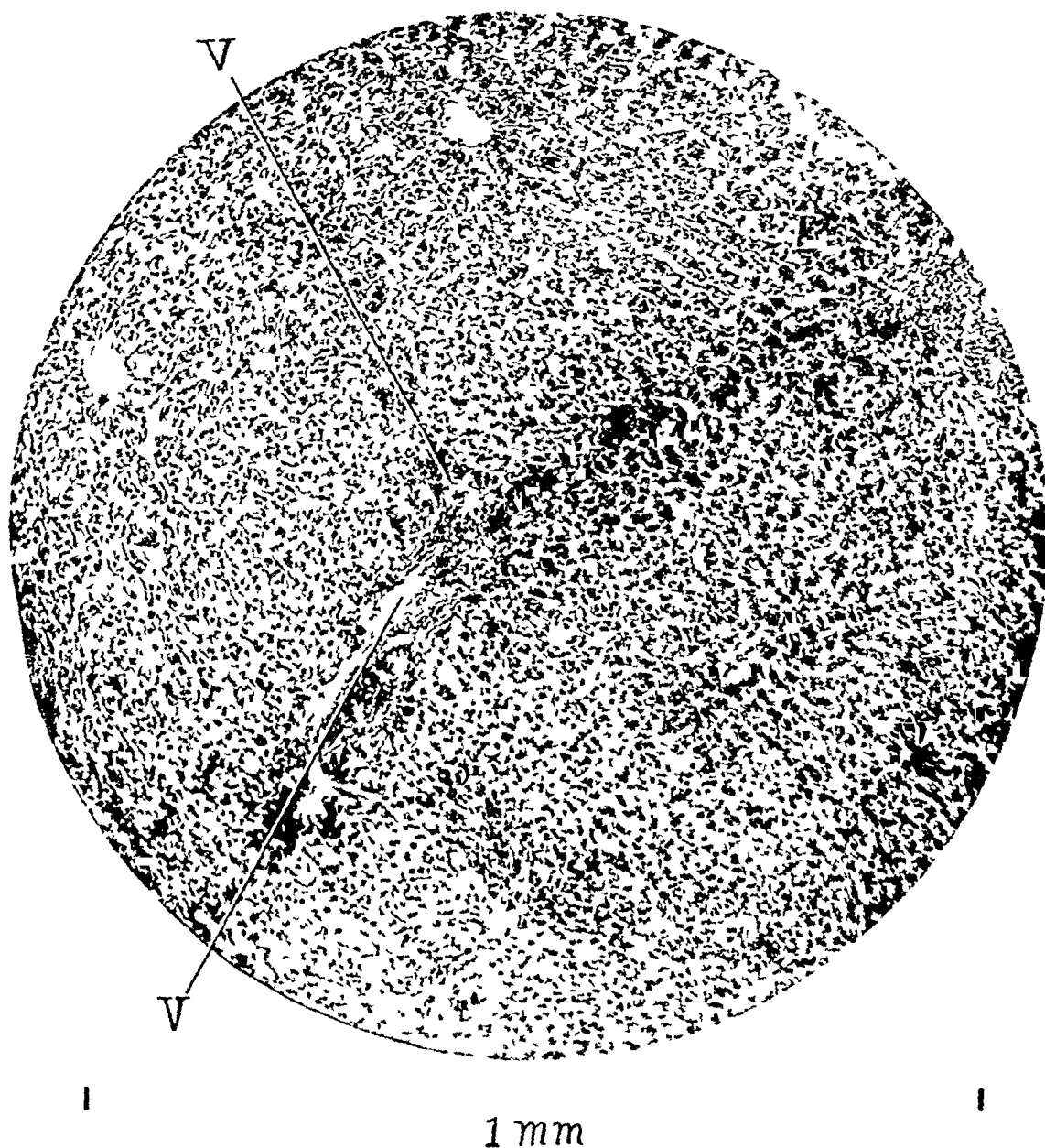


FIG. 1.—Case VIII. Section of liver showing moderate thickening in the fibrous trabeculae of Glisson's capsule with numerous wandering cells most abundant about the bile ducts. The picture is that of an irregular cirrhosis of an early stage, evidently of the biliary type. (V) Portal branches.

quite minimal as compared to those encountered in the liver. In so far as the gall-bladder was concerned as an etiologic factor in hepatic change it did not seem to make much difference whether stones were present or absent.

The essential elements were apparently (1) Chronicity of the infective processes, (2) the persistence of a certain degree of intensity of the offending agent, chemic or biochemic. In catarrhal types of appendicitis and cholecystitis, the evidence obtained from inspection of the liver consisted in a thickening of the capsule, with occasional adhesions, with thickening of the anterior border, with crenation, swelling and surface dimpling. In localized gall-bladder disease, the changes in the area of the gall-bladder region

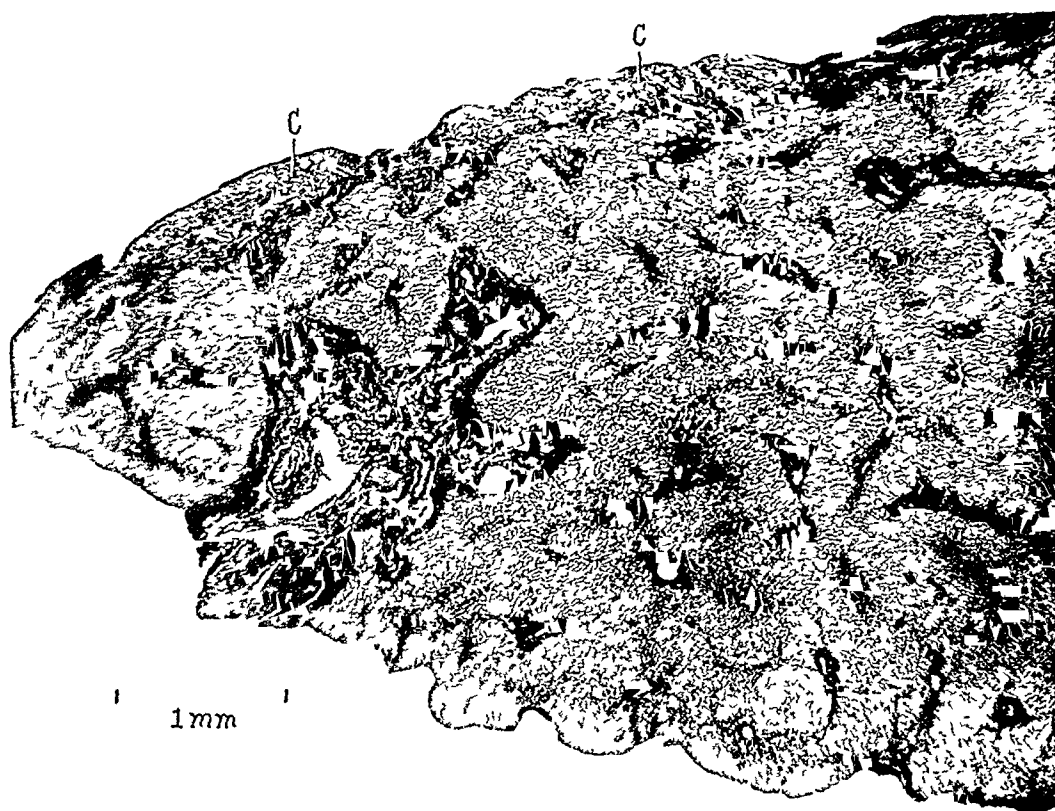


FIG 2 —Case XVII. Section of liver stained by Van Gieson's method to show the fibrous tissue which is increased in the external capsule and in the trabeculae within the liver substance. This specimen also shows abundant round-cell infiltration of connective-tissue and conspicuous small bile ducts features which are of course not evident in the photograph.

were more intense than elsewhere and the quality of the change varied inversely with the distance from the gall-bladder. In these cases the microscopic examination of the liver sections would show subscapular lymphocytic infiltration and intercellular lymphatic infiltration (Fig 1). If there were an acute inflammation in the appendix or gall-bladder, leucocytic infiltration would be merged with lymphocytic infiltration. When the abdominal condition was essentially chronic, the surface changes on the liver would become more marked and more diffuse, together with an increase in the size of the liver. The liver was grossly enlarged in about fifty per cent of all the cases and the enlargement, when present, was confined, in about ninety per cent of the cases, to the right lobe and particularly the outer and posterior half of the right lobe the quadrate and caudate lobes not participating in gross enlargement. Microscopically, the liver changes in the more chronic cases

represented an advance in pathologic intensity, with the chronicity of the abdominal conditions (Fig 2) Uniform fibrosis was more marked loose connective tissue would be found in abundance about the bile ducts and portal veins, bile stasis would be more apparent with hyperplasia and budding of immature bile ducts (Fig 3) Leucocytic and lymphocytic

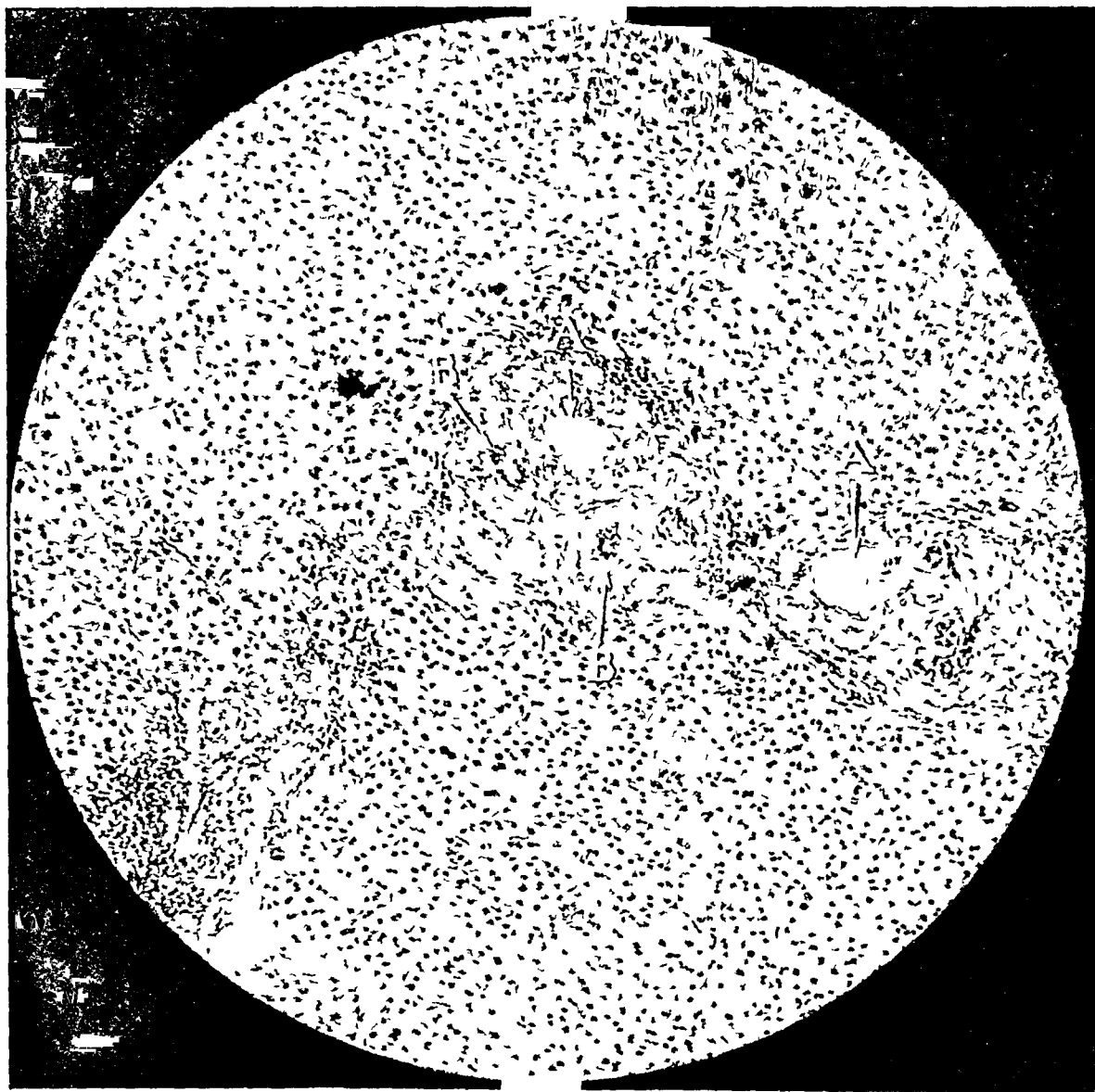


FIG 3—Case IV Chronic interstitial hepatitis and moderately early stage of biliary cirrhosis. The fibrous thickening of the trabeculae is marked and evidently of long standing. The round cells appear to be closely related to the bile ducts. The liver lobules appear smaller as if compressed. (A) Portal branches (B) Bile ducts

infiltration would extend between flattened and distorted liver cells (Fig 4) Many of the latter would show vacuoles and disintegration, occasionally intra- and intercellular pigment, with some fatty degeneration and hepatic cell destruction rarely hyperplasia of blood capillaries and an increase in syncytial cells of Kupffer. Apparently so far as we could observe there was no definite parallelism between the gross and qualitative liver changes and the pathologic condition of the associated abdominal condition. In some cases it was apparent that the force of the affection

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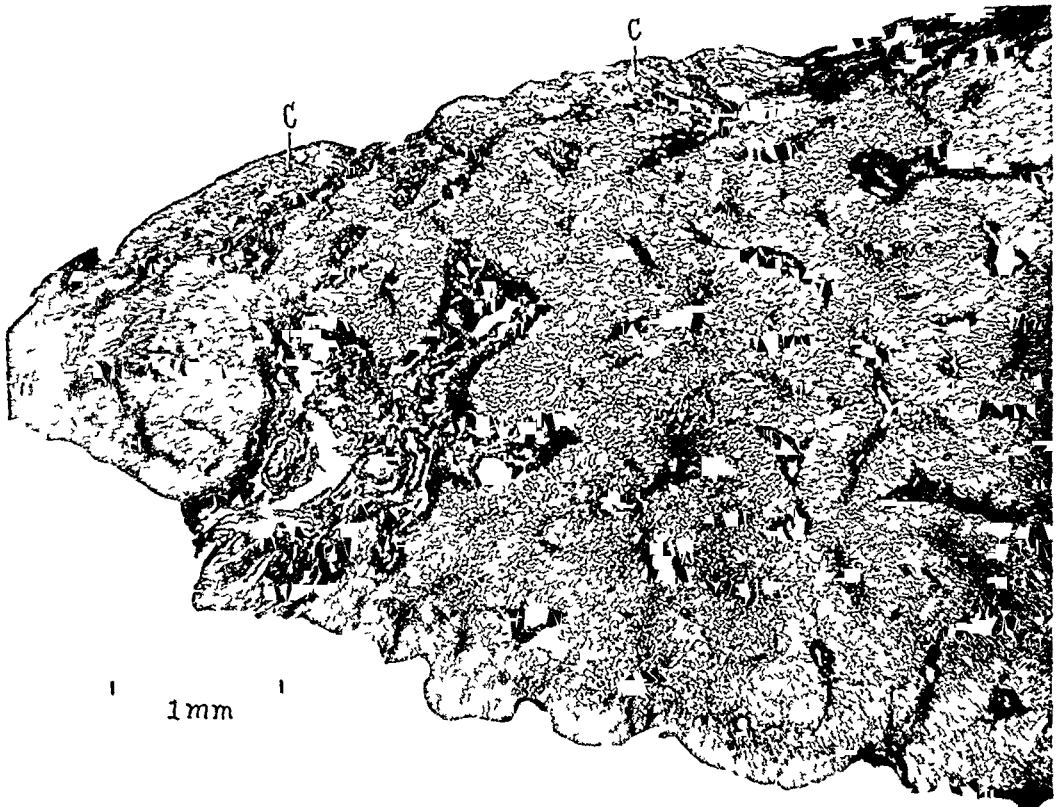


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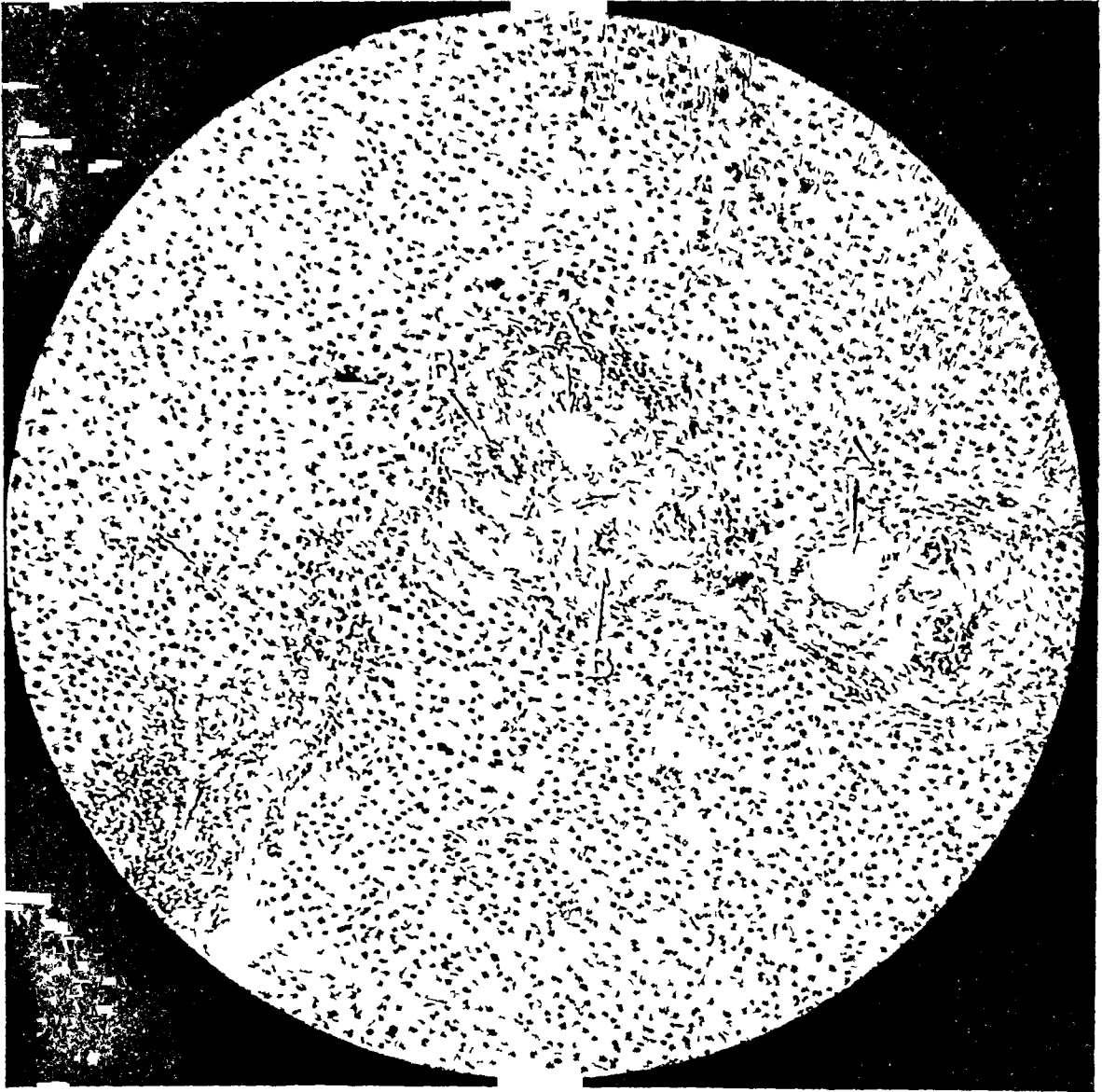


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was spent on the originally infected viscus, remote from the liver, in other cases the force of the offending agent apparently exerted its greatest injury

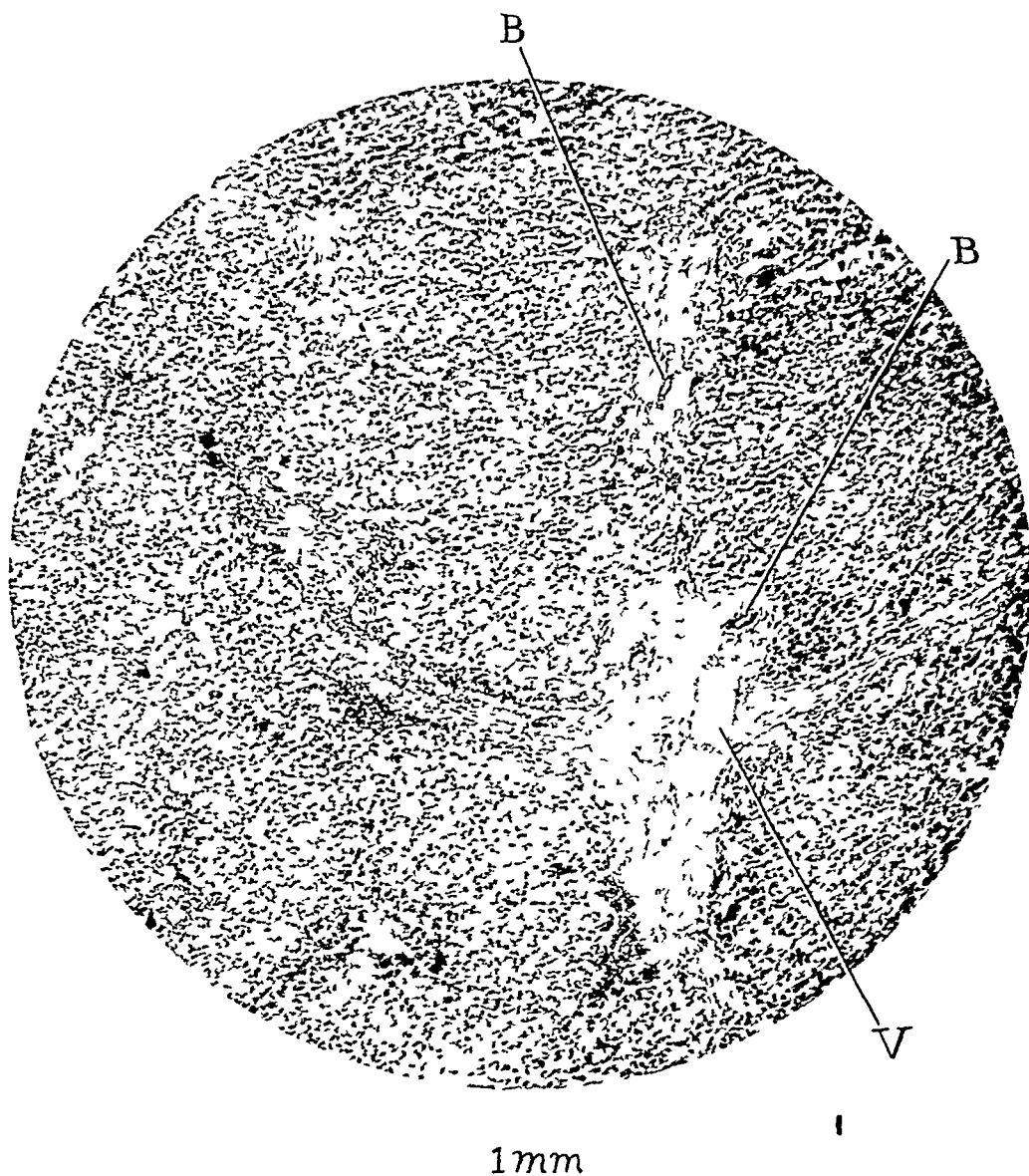


FIG. 4—Case XVII. Section of liver showing chronic interstitial hepatitis with conspicuous hyperplastic bile ducts. The fibrous tissue infiltrated with round cells rich in brown pigment. (B) Bile ducts (V) Portal branches

on the liver with minimal changes in the extrahepatic viscus which many times was showing a well-established repair

During the operation the histologic features of the liver could be anticipated by visible and macroscopic changes in the gross and general appearance

of the liver. The size of the liver, as it was viewed by the operator, was dismissed unless the apparent enlargement was so great as to call forth unusual comment. The macroscopic changes observed embraced variations in color, condition of the capsule, the presence of adhesions, retraction and

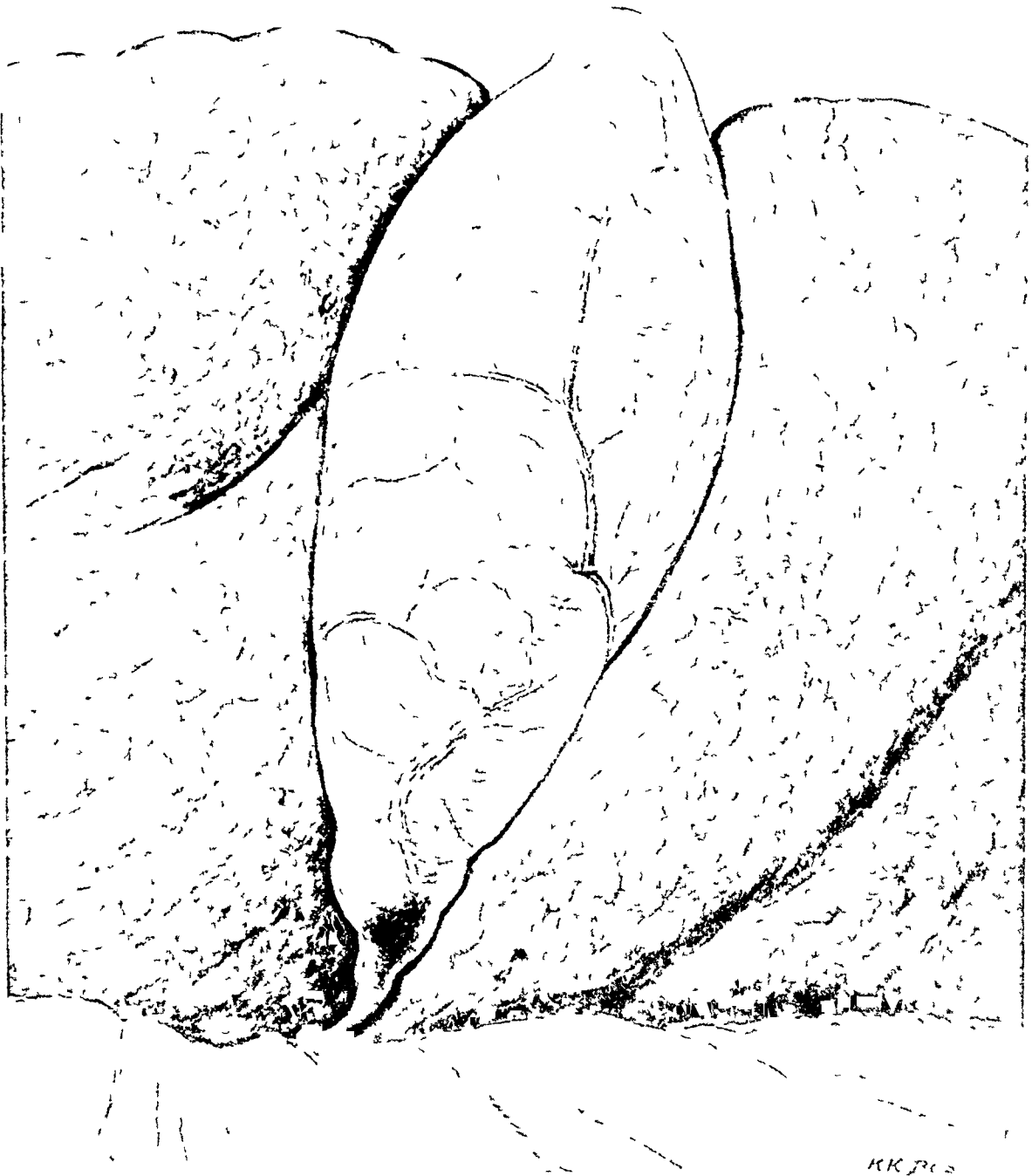


FIG 5—Case III. Actual drawing made at operation showing hydrops, crenation of liver edge, dimpling of liver surfaces with area of fibrotic replacement and the marked increase in fibrous tissue trabeculae.

crenation of the edges, disposition of the fibrous elements over the superior and ventral surfaces of the liver and an intrahepatic increase in the fibrous tissue elements as evidenced in the lessened tendency for the liver to tear. The capsule of Glisson was uniformly whitened, and in many cases of such density and opacity as to prevent the recognition of the normal liver color. In about one-third of the cases there were adhesions between the liver and the anterior abdominal wall. The capsule as it extended over the edge of

the liver seemed to be retracted, giving a crenated or festooned appearance to the edge of the liver. In the area of the gall-bladder, extending laterally both internally and externally, there would be an increase in the fibrous tissue elements so that the wall of the gall-bladder would pass insensibly into a white opaque area of fibrous tissue. These fibrous tissue elements were contracted and occasionally gave a marked dimpled appearance. Less frequently the fibrous plaques would extend laterally much after the fashion of a rosette, the centre being represented by the gall-bladder (Fig 5). When the gall-bladder was apparently the organ first affected, this fibrous tissue replacement reached its maximum in and about the gall-bladder. Where the stomach was involved these changes would be manifest on the left side as well as on the right side. Whether this can be taken as pointing to the lymphogenous infection of the gall-bladder and liver, and liver and gall-bladder, is capable of varied interpretation. The weight of evidence would seem to support the lymphogenous origin of gall-bladder and liver infection.

In cases showing liver changes, the color of the liver was of a marked yellow. The surface, as a rule, was not smooth but retracted and dimpled. Occasionally, the posterior and external half of the right liver would be markedly elongated into a linguiform process and would reveal an unusual degree of ductility in that there was practically no tearing of the liver tissue upon strong traction. It is my own impression, that the nearer the abdominal pathology was to the liver the more marked the changes, as the changes were most predominant in affections of the gall-bladder, and would progressively diminish with the distance away from the gall-bladder. Evidences of fibrous tissue replacement would extend toward the median line, passing over into the quadrate and caudate lobes, but stopping short at the division between the right and left lobes. On the other hand, where the abdominal infection began in areas remote from the gall-bladder, the fibrous tissue changes would appear more uniformly distributed throughout both right and left lobes of the liver.

Dr John A. Killian studied seventeen cases for changes in the blood coincident with disease of the liver and gall-bladder. In many of these cases the non-protein nitrogen exceeded the upper normal limit of 30 mg per 100 c.c. The urea nitrogen, on the contrary, does not show a corresponding increase, in fact, in some instances, it is subnormal. These findings would indicate a corresponding increase in the rest nitrogen. Little is known concerning the nature of the compounds constituting the rest nitrogen of the blood, but we believe an intensive study of the non-protein nitrogen partition of the blood will tell us more than we know at the present time concerning liver function. The normal blood sugar ranges from 0.90 to 0.120 per cent. In many cases of gall-bladder disease we find a mild hyperglycæmia from 0.140 to 0.200 per cent. Associated with this increased blood sugar is an increased activity of the blood diastase. It is well known that the pancreas regulates the activity of this blood enzyme and an inhibition of pancreatic function entails an abnormal diastatic activity. Apparently, then, the increased blood sugar sometimes encountered in gall-bladder disease may find its cause

in an associated disturbance of pancreatic function. On the other hand, in two cases we have found slight hypoglycæmias. The reason for these hypoglycæmias remains still a baffling question.

Since the liver has been regarded by some authorities as the site of formation of the fibrinogen of the blood, the fibrin content of the blood was studied in some cases. The normal fibrin content of the blood varies from 0.2 to 0.5 per cent. All of our determinations fall within the normal limits. These findings are of interest inasmuch as many of these cases manifested a delayed coagulation time. The calcium content of the blood sera of these patients was also determined. The calcium was found to be normal. This fact, however, does not contra-indicate the use of dilute solutions of calcium chloride to decrease the coagulation time because for the process of clotting ionizable calcium is essential.

OPERATIVE AND PATHOLOGIC DATA

CASE I—F. P., Chart No. 26951, female, age twenty-seven. Operative diagnosis, cholecystitis, cholelithiasis, appendicitis, interstitial hepatitis, fibroma of uterus, pelvic peritonitis. Operation, cholecystectomy, appendectomy. Gall-bladder, color is dirty, mottled brown, with loss of olive green, wall is thickened, contracted. No adhesions. Single calculus two cm. in diameter. Liver is enlarged ++, confined to right lobe; fibrotic areas over dorsal surface of right lobe of liver, left lobe comparatively free. Pancreas normal to palpation. Gastro-duodenal segment negative. Appendix distended, representing a mild subacute process. Remainder of abdomen negative. Sections of the gall-bladder show erosion of the rugæ over part of the surface and in other places they are thickened. The muscle coat is about four times the normal thickness and there is a very marked increase in its interstitial connective tissue. This is richly infiltrated with round cells, plasma cells and polymorphonuclear leucocytes. The outer coat is also thickened by œdema and increase of fibrous tissue. Its blood vessels are very much congested. Sections of the larger piece of liver (from right lobe) show a slight increase of connective tissue in the trabeculæ of Glisson's capsule. These trabeculæ outline the liver lobules more completely than under normal conditions. The connective tissue contains a slight excess of round cells which appear to be more intimately related to the bile ducts than to the portal branches. The liver columns are well preserved. There is a very small amount of brown pigment in the liver cells near the central vein and only very little visible fat. Sections of the smaller piece of liver (from left lobe) present a picture almost identical with that of the other piece, in fact, it has been impossible to detect any characteristic differences. Sections of the appendix show considerable inflammatory atrophy of the mucous membrane, with irregular thickening of the submucous layer in which there are dense collections of round cells, especially in the distal portion. The mucous membrane shows recent extravasations of blood. The subserous coat contains a moderate excess of round cells diffusely distributed, and it is somewhat thickened by œdema and increase of fibrous tissue. Pathological diagnosis. Chronic appendicitis, severe chronic cholecystitis, early biliary cirrhosis†.

† The descriptions of the operative findings are approximations only, and, of course, represent the personal equation of the operator. The + signs are used on a scale of four, and where denoting size may be relatively interpreted as equal to one centimetre. All of the observations are by the same operator, and although they vary from case to case in general, they represent a fair approximation. Where organs are not specified, it is assumed that they were normal.

CASE II—B K, Chart No 24682, female, age fifty Operative diagnosis, cholecystitis, subacute, cholelithiasis, diseased appendix, hepato-omental adhesions, operation, cholecystectomy, appendectomy, separation of adhesions Gall-bladder opaque white walls, markedly thickened, no adhesions, about 150 calculi of sulphur color Liver ++, edges fibrotic, retracted and indented Considerable thickening of Glisson's capsule Pancreas negative Gastro-duodenal segment negative Appendix, partial obliteration Remainder of abdomen negative The epithelium of the gall-bladder is preserved over most of the interior of the gall-bladder, but there are several points of ulceration where the epithelium is lacking and the exposed fibrous tissue is richly infiltrated with polymorphonuclear leucocytes and with large endothelial cells filled with blood pigment The muscle bundles are slightly hypertrophied and there is moderate thickening of the interstitial connective tissue The outer fibrous coat is also thickened Round cells and polymorphonuclear leucocytes are present in excess throughout the entire thickness of the wall The dense collections in the ulcerated area are purulent in character Sections of the liver specimen show a remarkable increase of fibrous tissue near one end of the specimen Here one sees nothing but fibrous connective tissue, blood vessels and bile ducts over a triangular area which is approximately 3 mm in diameter At its base this triangular area includes a few columns of liver cells The adjacent liver tissue shows general thickening of the trabeculae of Glisson's capsule, and there is especially marked fibrous thickening about the larger bile ducts which occur in this region One of these bile ducts is about 0.8 mm in diameter The fibrous tissue around it is from 3 to 5 mm in thickness The liver tissue near the other end of the section also shows marked increase in the thickness of the trabeculae and this connective tissue is diffusely infiltrated with round cells In this portion the liver columns appear to be well preserved and the lobules retain their normal shape and relationships The picture bears some resemblance to that of Laennec's cirrhosis, but the fibrosis is far advanced at one end of the section and just beginning at the other The increase of fibrous tissue occurs about the bile ducts and blood vessels, but is distinctly more dense about the bile ducts Apparently this specimen comes from near one of the large branches of the hepatic duct It also includes large blood vessels Sections of the appendix show food remnants mingled with exfoliated epithelium in the lumen The mucous membrane shows large areas of atrophy There is a very slight excess of round cells in the subserous coat, but the inflammation appears not to be active at the present Pathologic diagnosis Chronic interstitial hepatitis, and irregular cirrhosis, apparently originating about the bile ducts, chronic appendicitis, cholelithiasis and chronic cholecystitis with ulceration and severe acute purulent exacerbation of the inflammation

CASE III—M N, Chart No 24433, female, age forty-seven Operative diagnosis, hydrops of gall-bladder, cholelithiasis, diseased appendix, hepatitis, chronic, operation, cholecystectomy, appendectomy Gall-bladder, size of Bartlett pear, color, entire absence of green color, contains white bile, wall is markedly thickened, cystic duct obstructed, calculi, about 75 stones from 1 to 2 cm in diameter Liver +++++, marked Reidel's lobe, extending down to crest of ileum, dimpling on surface of liver, retraction and crenation of edge of liver, marked fibrosis Pancreas negative Gastro-duodenal segment negative Appendix distended, thickened walls, considerable adhesions Uterus and ovaries atrophied Sections from the fundus of the gall-bladder show extensive loss of the corrugations of the mucous membrane The muscle bundles lie very close to the thin epithelium The entire mucous membrane is very atrophic as a result of chronic inflammation The muscle bundles are approximately three times the normal thickness and there is an excess of round cells in the interstitial connective tissue of the muscle layer The outer fibrous coat is thickened to a slight extent The picture indicates a

most marked change in the lining mucous membrane with hypertrophy of the muscle. Sections of the gall-bladder near the neck show the mucous membrane much better preserved. Here the rugæ are somewhat irregularly thickened by increase of stroma. The muscle layer is also about three times the normal thickness and contains an excess of round cells in its interstitial connective tissue. The outer fibrous layer of the gall-bladder is moderately thickened in this region and it is diffusely infiltrated with round cells. In this portion of the gall-bladder the inflammatory reaction is diffuse and has not progressed to destruction of the mucous membrane. Sections of the piece of liver show a moderate increase in connective tissue of the trabeculæ of Glisson's capsule within the substance of the liver. In this connective tissue there are excessive numbers of round cells and in some places conspicuous small bile ducts, apparently hyperplastic. The columns of liver cells are well preserved, but among the liver cells there are some very large nuclei. The endothelial cells lining the blood sinuses are somewhat more numerous and more deeply staining than usual, and in these endothelial cells one finds an occasional mitotic division figure. In the sinuses there appears to be also slight excess of round cells and polymorphonuclear leucocytes. The round-cell infiltration in the connective-tissue trabeculæ is rather diffuse, and it is impossible to recognize that it has a closer relation to the bile ducts than the tributaries of the portal vein. The histological picture is that of a subacute interstitial hepatitis and early cirrhosis, apparently of more recent origin than the inflammation in the gall-bladder. Sections of the appendix show marked atrophy of the mucous membrane near the tip and in this region there are compact collections of round cells in the subserous coat. In the remainder of the appendix there are small areas of atrophy but no definite inflammatory infiltration. Pathologic diagnosis. Chronic appendicitis, severe chronic cholecystitis, cholelithiasis, subacute interstitial hepatitis.

CASE IV—A McC, Chart No 26893, male, age forty-six. Operative diagnosis, cholecystitis, subacute, cholelithiasis, interstitial hepatitis, pancreatitis, slight, subacute appendicitis, operation, cholecystectomy, appendectomy. Gall-bladder, dirty, brown color, no green tinge, walls markedly thickened, few pericholecystic adhesions, 400 fine sulphur-colored calculi, glands along the common duct enlarged, liver +, marked fibrosis over surface of liver, particularly of right lobe of liver and adjacent to gall-bladder, with white fibrotic spots one-half cm in diameter, color, markedly pale yellow, pancreas, abnormal hardness. Gastro-duodenal segment normal. Appendix distended, with increased thickness of the walls. Remainder of abdomen negative. Sections of the gall-bladder show extensive loss of the lining epithelium, which remains in the deeper portions of the crypts. The muscle bundles are irregularly thickened and in some places the muscle layer attains a thickness of 1 mm. There has been an enormous production of inflammatory fibrous tissue, which extends throughout the thickness of the wall. In this there are abundant round cells, polymorphonuclear leucocytes and conspicuous eosinophilic leucocytes, all of which are more abundant near the internal surface. The epithelial cells lining the deeper gland crypts are somewhat irregular in size, shape and staining qualities, but they appear to rest everywhere on a basement membrane. Sections of liver show a very definite increase of fibrous tissue in the trabeculæ of Glisson's capsule, which in many places attain a thickness of one-fifth mm. This fibrous tissue is rather dense and evidently of considerable standing. It contains an excess of round cells and very conspicuous bile ducts. The round cells appear to be closely related to the bile ducts. Branches of the portal vein and hepatic artery are not surrounded by the round cells to the same degree. The liver lobules appear smaller, as if compressed by the trabeculæ of the capsule. In many of them the

intra-lobular vein is eccentric in position. One sees also deposits of brown pigment in the liver cells adjacent to the intra-lobular vein. The hepatic cells appear otherwise normal. There is no evident excess of fat. Sections of the appendix show marked inflammatory atrophy of the mucous membrane with small deposits of blood pigment in it. The submucous layer is irregularly thickened, but the outer coats of the appendix appear negative. Pathologic diagnosis: Chronic interstitial hepatitis, evidently of biliary origin, moderately early stage of biliary cirrhosis, chronic appendicitis, severe chronic ulcerative cholecystitis, cholelithiasis.

CASE V—J. S., Chart No. 31524, female, age forty-seven. Operative diagnosis, cholecystitis, non-calculous, hepatitis, interstitial, chronic, appendicitis, chronic, operation, cholecystectomy, appendectomy. Gall-bladder, yellow-white color, walls thickened, marked pericholecystitis, no calculi, liver ++, marked Glissonitis, moderate trabeculation of surface, crenation and retraction of edges, on palpation feels leathery, left lobe participates in the same changes as the right, the liver changes of greater intensity than pathologic changes in gall-bladder. Pancreas negative. Gastro-duodenal segment negative. Remainder of abdomen negative. Sections of the gall-bladder show well-preserved mucous membrane over most of the interior. In some places there is irregular thickening of the rugæ and in these regions the muscle bundles are hypertrophied so that the muscle layer is nearly double the thickness. There is no indication of active inflammation at the present time. The outer coat is negative. Sections of the liver show a distinct thickening of the fibrous trabeculae of Glisson's capsule and this thickening would appear to be of long standing, as there is very little evidence of round-cell infiltration. The lobules of the liver are more distinctly outlined than normal, but their cell columns are well formed and the lobules themselves are negative. Sections of the appendix show moderate inflammatory atrophy of the mucous membrane and a few extravasations of blood into it. The outer coats of the appendix appear negative. Pathologic diagnosis: Chronic, inactive appendicitis, chronic, inactive cholecystitis of mild type, chronic interstitial hepatitis, only slightly active.

CASE VI—M. S., Chart No. 29023, female, age forty-two. Operative diagnosis, cholecystitis, non-calculous, appendicitis, chronic, with evidence of old perforation, omental adhesions, operation, cholecystectomy, appendectomy. Gall-bladder, white, contracted, fibrotic, walls thickened, no calculi, liver ++, considerable fibrosis of Glisson's capsule, more pronounced in right lobe, crenation and retraction of liver edge (repeated Widal tests for liver function negative), pancreas negative. Gastro-duodenal segment negative. Appendix, terminal two-thirds obliterated, terminal one-third ballooned out with retained material, evidently the seat of old perforation, marked periappendiceal adhesions. Numerous small fibroids. Sections of the gall-bladder show slender rugæ which are deeply stained with bile. The muscular and fibrous coats appear to be very slightly thickened by increase of connective tissue and there is, perhaps, a slight excess of round cells in the interstitial tissue of the muscle coat. There has evidently been only a slight inflammation of the gall-bladder. Sections from the right lobe of the liver show a very considerable increase of fibrous tissue in the trabeculae of Glisson's capsule. The liver lobules are quite irregular in size and some of them are evidently compressed by connective-tissue trabeculae. The fibrous tissue appears to be most dense immediately about the larger bile ducts and it contains, in some places, a marked excess of round cells. In other places it is more hyaline and contains relatively few round cells. The liver columns and the cells appear negative. Sections from the left lobe of the liver appear more nearly normal. There is however, also a definite increase of fibrous tissue in the trabeculae about the bile ducts, although it is less marked than in the specimen from the other

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lobe Sections of the appendix reveal no sign of lumen nor of lining mucous membrane The obliterating fibrous tissue contains very few small collections of round cells It is evidently of long standing Pathologic diagnosis Obliterated appendix, very mild chronic cholecystitis, moderate chronic interstitial hepatitis, more marked in the specimen from the right lobe of the liver

CASE VII—C K, Chart No 25320, female, age thirty Operative diagnosis, cholecystitis, subacute, appendicitis, subacute, hepatitis, operation, cholecystectomy, appendectomy Gall-bladder, mottled, brown-white, walls markedly thickened, injected veins, marked hyperplasia of gland along cystic and common duct, no adhesions, no calculi, liver, right lobe ++, posterior half of right lobe shows the greatest enlargement, considerable white trabeculation over surface of liver with fibrous tissue contraction, numerous white plaques diverging from the area of the gall-bladder, consistency more leathery than normal Sections of the gall-bladder show moderate thickening of the stroma of the rugæ and the gland crypts extend deep down into the muscle layer The muscle bundles are approximately twice the normal thickness and the connective-tissue between them is thickened and contains an excess of round cells There is moderate fibrous thickening of the outer coat Some of the rugæ show a xanthomatous degeneration of the stroma The piece of liver shows slight thickening of the trabeculæ of Glisson's capsule, in which the bile ducts are slightly more conspicuous than normal and there are collections of round cells in this tissue, apparently related to the bile ducts more closely than to the portal branches The lobules of liver parenchyma appear negative The lumen of the appendix contains food remnants mingled with exfoliated epithelium The mucous membrane contains brown blood pigment and also recent extravasations of blood It shows spots of inflammatory atrophy also The outer coats of the appendix contain a slight excess of round cells Pathologic diagnosis Chronic appendicitis, chronic cholecystitis, beginning cirrhosis of the biliary type

CASE VIII—M A, Chart No 21441, female, age fifty-nine Operative diagnosis, cholecystitis "strawberry" type, cholelithiasis, appendicitis, subacute, hepatitis, chronic, operation, appendectomy, freeing abdominal adhesions, cholecystectomy Gall-bladder markedly inflamed, dilated blood vessels over surface, hyperplasia of gland over cystic and common ducts, wall markedly thickened, numerous adhesions to hepatic flexure and omentum, numerous small calculi, liver +, numerous adhesions on superior surface, white fibrotic areas one-half cm in diameter, crenation and dimpling of liver surface Pancreas abnormally hard Gastro-duodenal segment negative except for adhesions Appendix partially obliterated, subcæcal, numerous adhesions Remainder of abdomen negative Sections of the gall-bladder show thickening and partial loss of the corrugations of the mucous membrane The muscle layer is moderately thickened and there is an excess of round cells in its interstitial connective-tissue The outer coat appears negative Here the most striking change appears to be in the mucous membrane and in the hypertrophied muscle bundles Sections of the liver show a fibrous nodule, 4 mm in diameter, embedded in the liver substance The centre of this nodule is necrotic and disintegrated Around the necrotic material is hyaline dense fibrous tissue in which there are irregular spaces from which lypoid material appears to have been dissolved out There is a rather dense but irregular zone of lymphocytic infiltration walling off the fibrous nodule from the liver substance The interpretation of this nodule is a problem which has not been solved It may represent an area of focal necrosis, of ancient origin, or it may represent a cyst of some parasitic worm possibly cysticercus It has been impossible to find any elements in the cyst which will serve to identify its nature The liver substance shows slight increase of connective-tissue in the trabeculæ of Glisson's capsule

and there is a definite increase of round cells in this connective tissue. The liver cells, themselves, contain numerous fat globules, more especially at a short distance from the central vein of the lobule. The changes in the liver, aside from the large fibrous nodule, are not very marked in this case. The obliterating fibrous tissue in the distal portion of the appendix contains a considerable number of round cells and there are dense collections of them in the thickened subserous layer in this region. In the proximal portion of the appendix, the lumen is still patent, but here there is irregular inflammatory atrophy of the mucous membrane and thickening of the submucous layer in which one finds dense collections of round cells. The subserous coat here also is thickened by increase of fibrous tissue and contains an excess of round cells. The picture indicates a rather recent exacerbation of a chronic inflammation. Pathologic diagnosis: Chronic appendicitis with evidence of a severe exacerbation, still active, chronic cholecystitis, relatively quiescent, cholelithiasis, dense fibrous nodule in liver, necrotic in its centre, possibly a parasitic cyst, slight diffuse interstitial hepatitis.

CASE IX—A L, Chart No 24776 male, age fifty-one. Operative diagnosis, cholecystitis, acute, empyema, cholelithiasis, chronic appendicitis, operation, cholecystectomy, intramural enucleation of mucous membrane, appendectomy, paracentesis of liver. Gall-bladder, size of Bartlett pear, strawberry red, marked thickening of the wall, with gangrenous areas between liver and gall-bladder, marked adhesions of omentum and hepatic flexure to gall-bladder, two calculi, two and three cm in diameter. Liver + + + œdematous, surface of liver in area of gall-bladder shows a yellow-green, mottled area, three by five cm non-fluctuant, suggesting abscess, covered with fine granulation tissue, remaining surface of liver shows numerous white fibrotic areas, more marked on the right side. Pancreas swollen, apparently of normal consistency. Gastro-duodenal segment negative except for some hypervascularization. Appendix submesenteric, partially obliterated, with adhesions. Remainder of abdomen negative. Sections of the gall-bladder show no lining epithelium and the mucous membrane appears to have been entirely destroyed. The internal surface is covered with partly necrotic fibrino-purulent exudate. The entire wall is œdematous and infiltrated with hemorrhagic pus. The muscle bundles are moderately thickened. There are small abscesses in the wall outside the muscle coat. Sections of the liver show slight thickening of the trabeculæ of Glisson's capsule and these trabeculæ are everywhere richly infiltrated with round cells. These round cells appear to be somewhat more compactly grouped about the branches of the portal vein. The bile ducts are not very conspicuous. The columns of liver cells are well preserved, but they show a moderate amount of fat deposit near the central vein. Sections of the appendix show large extravasations of blood into the mucous membrane and a small amount of blood in the lumen. The hemorrhages into the mucous membrane are in part very recent, but some of them are of longer standing and the blood has already begun to disintegrate. The mucous membrane shows large areas of atrophy and there is a slight excess of round cells in the subserous coat. The picture is that of a chronic appendicitis with slight activity of the inflammatory process at the present moment. Pathologic diagnosis: Mild chronic interstitial hepatitis, apparently periportal in distribution, phlegmonous cholecystitis, supervening upon chronic inflammation, chronic appendicitis.

CASE X—E W, Chart No 24895, male, age thirty-one. Operative diagnosis, appendicitis, subacute, cholecystitis, acute, operation, cholecystectomy, appendectomy. Gall-bladder markedly distended, adherent to the duodenum and transverse colon, walls thickened, hyperplasia of lymph-glands, no calculi. Liver +, considerable œdema, few white lines about gall-bladder, does not give impression of any degree of hepatitis. Pancreas negative. Gastro-duodenal segment negative.

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Appendix swollen, turgid, lumen distended, markedly reddened. Remainder of abdomen negative. Sections of the gall-bladder show slender rugæ on the mucous membrane. There are a few spots of erosion beneath which the stroma is dense and infiltrated, with elongated wandering cells, but here the wall is only slightly thickened. The muscular coat appears normal. The connective tissue outside of it is also negative. The inflammatory infiltration in the gall-bladder is confined to the superficial portions of the internal surface, and here it occurs in small areas which appear to be ulcerated. The density of the fibrous tissue at the base of these ulcers indicates a duration of a few weeks. Section of the liver shows a slight and somewhat irregular thickening of the superficial capsule at one corner of the section. Here there is an irregular intermingling of fibrous tissue with columns of liver cells and the fibrous tissue is infiltrated with round cells. This lesion is quite local. In the remainder of the section the liver columns are well preserved and there appears to be no thickening of the trabeculæ of connective tissue. The liver in general is, therefore, negative. The significance of the local fibrous thickening is quite doubtful. The mucous membrane of the appendix shows small areas of inflammatory atrophy and there is a slight excess of round cells in the subserous coat. There is no evidence of active inflammation at the present moment. Pathologic diagnosis: Chronic appendicitis, subacute cholecystitis with small ulcerations of the mucous membrane, localized scar in the liver.

CASE XI—J. F., Chart No. 26807, male, age thirty-four. Operative diagnosis, chronic appendicitis with omental adhesions, omental sigmoidal adhesions, pancreatic fibrosis, operation, appendectomy, division of adhesions. Gall-bladder apparently normal, liver apparently normal. Pancreas presented a corrugated sensation upon palpation with hardness suggesting a moderate degree of fibrous pancreatitis. Gastro-duodenal segment is negative, except for slightly increased hypervascularization at the pylorus. Appendix is adherent to the right lateral wall, shows evidence of old periappendicitis. Remainder of abdomen, attachment of the sigmoid midpoint to anterior abdominal wall. Sections of the liver do not reveal any definite increase of fibrous tissue. The trabeculæ of Glisson's capsule appear normal, except for a slight excess of round cells about the bile ducts. The columns of liver cells contain a large amount of brown pigment in fine granules, more abundant in the vicinity of the central vein. There is also a moderate excess of fat in the liver cells existing for the most part as fine globules. This liver is more nearly normal than the others which have been examined from appendix-gall-bladder cases. The obliterating fibrous tissue at the tip of the appendix contains a large amount of fat and relatively few inflammatory cells. It is evidently of long standing. Near the patent portion of the lumen, however, there are dense collections of round cells. There is moderate inflammatory atrophy of the mucous membrane in the proximal portion with corresponding fibrous thickening of the submucous layer. There is a moderate excess of round cells in the muscle layer and in the subserous coat. Pathologic diagnosis, chronic appendicitis, with partial obliteration at the tip, liver negative.

CASE XII—A. P., Chart No. 28876, male, age seventeen. Operative diagnosis, appendicitis, chronic, tuberculous peritonitis, adenitis, mesenteric, tuberculous, operation, appendectomy, resection of tuberculous gland, lavage of peritoneal cavity with hydrogen peroxide. Gall-bladder, lost its olivary-green color, walls are thickened, otherwise negative. Liver in area of gall-bladder, number of small discrete white plaques, size of pinhead, suggesting recent inflammatory reaction or tuberculous implantations. Gastro-duodenal segment negative. Appendix rather elongated, with slight external evidence of infection. Ileocaecal region number of lymph-nodules in region of mesentery. No gross pathology in caecum itself. Sections of the first lymph-node show a fibrous capsule less than one mm

thick surrounding the partly calcified caseous material. Remnants of lymphoid tissue are seen in the capsule and in some places there are groups of epithelioid cells with an occasional Langhans' giant cell. Increase of the fibrous tissue has almost obliterated the evidence of tuberculosis and the picture is that of a nearly healed tuberculous process. Sections of the second lymph-node show an increase of fibrous stroma and endothelial elements, but tubercles are not recognized. Sections of the liver show slight irregular thickening of the external capsule and a moderate increase in fibrous tissue in the internal trabeculae. In the latter there is a moderate excess of round cells and small bile ducts are fairly conspicuous. Tubercles are not recognized. The lumen of the appendix contains food remnants. There is considerable inflammatory atrophy of the mucous membrane and scattered deposits of brown blood pigment in it. The outer coats of the appendix appear negative. Tubercles are not recognized in the appendix. Pathologic diagnosis: Chronic appendicitis, calcified mesenteric lymph-node showing partially healed tuberculous process, slight interstitial hepatitis of uncertain causation.

CASE XIII—J. G., Chart No. 25690, male, age twenty-six. Operative diagnosis, appendicitis, acute, operation, appendectomy. Gall-bladder, white, opaque color, walls slightly thickened. Liver presents a diffuse white mottled appearance. Pancreas is negative. Gastro-duodenal segment negative. Appendix is nine cm long, two cm in diameter, filled with fecal material, suggesting a hyperplastic tuberculous appendix. Remainder of abdomen negative. Sections of the liver show a distinct but moderate thickening of the fibrous trabeculae of Glisson's capsule. In the fibrous tissue are moderately numerous wandering cells which are elongated in the spaces between the fibres. These wandering cells are slightly more abundant about the bile ducts than elsewhere. The liver lobules are somewhat irregular in size and shape and in some places the columns appear to be pressed together. The picture is that of a somewhat irregular cirrhosis of an early stage, evidently of the biliary type. Sections of the appendix show recent extravasations of blood into the mucous membrane. The entire thickness of the wall is oedematous and infiltrated with round cells and polymorphonuclear leucocytes. The subserous coat is greatly thickened and shows fibroblastic proliferation, as well as large numbers of wandering cells. The picture is that of a severe purulent appendicitis of several days' duration. Pathologic diagnosis: Severe subacute purulent appendicitis, early biliary cirrhosis of liver.

CASE XIV—J. G., Chart No. 28512, female, age twenty-two. Operative diagnosis, subacute appendicitis, chronic cholecystitis, non-calculous, operation, appendectomy, cholecystectomy. Gall-bladder small, contracted, absence of green color, considerable thickening of walls, papillomatous appearance of mucous membrane. Liver + +, confined to right side, numerous plaques over the superior surface of the liver. Pancreas negative. Gastro-duodenal segment negative. Appendix seven cm in length, bulbous extremity, numerous adhesions. Remainder of abdomen, moderate visceroptosis. Sections of the gall-bladder show slight thickening of the stroma of the rugae. The muscle coat is also slightly thickened and there is a marked excess of round cells and polymorphonuclear leucocytes in its interstitial connective tissue. This inflammatory infiltration extends only a short distance into the outer connective-tissue coat. The inflammation of the gall-bladder is moderate in degree and duration. Sections of the liver show a moderate thickening of the trabeculae of Glisson's capsule and the fibrous tissue appears to be more dense about the larger bile ducts than elsewhere. In some places this fibrous tissue is hyaline with only a few round cells in it. In other regions there is less fibrosis and a very marked excess of round cells. The liver columns stain somewhat irregularly and in the central portion of the lobule they contain brown pigment. There does not appear to be any excess of fat, however, the lumen of

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the appendix contains a small amount of exfoliated epithelium. The mucous membrane appears well preserved. There is, however, irregular thickening of the submucous layer and occasional dense collections of round cells in it. The subserous coat is also rather richly infiltrated with round cells and there are collections of plasma cells in some places. Round-cell infiltration is also present in the muscle layer. Pathologic diagnosis, chronic appendicitis, with evidence of a fairly recent severe attack, subacute cholecystitis, interstitial hepatitis of very moderate grade, showing evidences of exacerbation from time to time.

CASE XV—H F, Chart No 25128, female, age twenty-four. Operative diagnosis, chronic appendicitis, cæcum mobile, mild hepatitis, chronic cholecystitis, operation, appendectomy, cæcoplication. Gall-bladder, walls slightly thickened, otherwise negative, except for more than normal vascularization. Liver, thin edge, with enlargement of the right lobe, uniformly distributed over the upper portion numerous white patches strongly suggestive of chronic hepatitis. Pancreas negative. Gastro-duodenal segment negative. Appendix infantile in type, contains fecoliths, considerable congestion. Remainder of abdomen, moderate degree of visceroptosis. Sections of the liver show considerable thickening of the trabeculae of Glisson's capsule and in this thickened fibrous tissue the bile ducts are rather conspicuous. The fibrous tissue is dense and hyaline and contains only a moderate excess of round cells. The columns of liver cells appear to be well preserved. There is only a moderate amount of brown pigment in these cells. The picture resembles that of an early stage of biliary cirrhosis, but the hyaline character of the trabeculae shows that the process has already existed for many months. The lumen of the appendix contains food remnants. The mucous membrane shows large spots of inflammatory atrophy and in some places there is a large amount of brown hæmatogenous pigment between the gland crypts, most of it contained within phagocytic cells. There is a slight excess of round cells in the subserous coat. Pathologic diagnosis, Moderate biliary cirrhosis, chronic appendicitis.

CASE XVI—K H, Chart No 27361, male, age forty-three. Operative diagnosis, ulcer, pyloric, superior, chronic appendicitis, operation, posterior gastro-enterostomy, appendectomy. Gall-bladder surgically negative. Liver negative. Gastro-duodenal segment, just proximal to the pylorus on the superior curvature of the stomach, subacute ulcer of the stomach with hypervascularization, stippling and infiltration. Appendix, moderate degree of inflammatory change. Sections of the liver show a very slight increase in the connective tissue of the trabeculae of Glisson's capsule, possibly not more than would be normal for the age forty-three. There is, however, a moderate excess of round cells in these trabeculae, very abundant in some places. These round cells appear to be closely related to the bile ducts, especially the smaller bile ducts. The larger bile ducts show fibrous thickening of their walls with a slight excess of round cells. The columns of liver cells are well preserved and contain a large amount of brown pigment in the central zone of the lobule. Sections of the appendix show the lumen to be obliterated at the tip. The obliterating fibrous tissue contains a moderate number of round cells and would appear to be of fairly recent origin. In the proximal portion of the appendix the mucous membrane is fairly well preserved. The outer coats of the appendix contain an excess of round cells in the distal portion. Pathologic diagnosis, subacute interstitial hepatitis of mild grade, apparently a very early stage of biliary cirrhosis, chronic appendicitis with fairly recent obliteration at the tip.

CASE XVII—I C, Chart No 25647, male, age fifty-three. Operative diagnosis, ulcer, pyloric, pyloric obstruction, diseased appendix, operation, gastro-enterostomy, posterior, appendectomy. Gall-bladder negative. Liver, mild degree

of yellow-white mottling Gastro-duodenal segment, a prepyloric infiltrating annular tumor extending backward toward the head of the pancreas, with considerable secondary enlargement of the duodenal section of pancreas Gastric wall markedly hypertrophied, pylorus about 75 per cent obstructed, no evidence of glandular involvement Appendix about seven inches in length infantile in type, partially obliterated Remainder of abdomen negative Sections of the liver specimen show a very marked fibrous thickening of the external capsule, especially in the vicinity of the small depression in it The fibrous tissue here is extensively infiltrated with round cells and there are numerous irregular bile ducts running through the fibrous tissue The adjacent liver lobules are considerably distorted and the fibrous trabeculae of the capsule, extending into the liver substance, are considerably thickened and infiltrated with round cells The bile ducts appear to be hyperplastic and are very conspicuous in the trabeculae The central veins of the lobules are surrounded by liver cells rich in brown pigment There is also a considerable hyperplasia of the endothelial lining and of the fibrillar connective tissue of the central veins Sections of the appendix show food remnants in the lumen and the mucous membrane contains deposits of brown blood pigment and also small recent hemorrhages It is in part atrophic The submucous layer contains a few compact collections of round cells There is also an excess of round cells in the muscle coat and in the subserous layer Pathologic diagnosis, chronic appendicitis, chronic interstitial hepatitis, apparently closely related to the bile ducts

CASE XVIII—A A, Chart No 28874, male, age sixty-five Operative diagnosis, carcinoma, gastric, secondary to old ulcer of lesser curvature, midportion, ascites, operation, exploratory laparotomy Gall-bladder negative Liver ++, enlarged No evidence of metastasis on surface Numerous metastases on central fissure Gastro-duodenal segment, anterior surface of stomach, chronic, calloused ulcer 3 cm from the lesser curvature, occupying midposition in the stomach, extending in all directions an infiltrating carcinoma Glandular involvement along greater and lesser curvature with extension downward through gastro-colic omentum Appendix undisturbed Remainder of abdomen, general carcinomatosis Sections of the liver show irregular thickening of the external capsule and a moderate thickening of the fibrous trabeculae in the interior of the liver Neoplasm is not found in the liver section Sections of the first specimen show adipose tissue containing a lymph-node In the adipose tissue, as well as in the lymph-node itself, are irregular small nests and small alveoli of epithelial cells These cells have a rather pale cytoplasm Their nuclei are irregular in size and shape, but in general are large in proportion to the size of the cells Mitotic division figures are present in small numbers The site of the primary tumor cannot be recognized, but the appearance suggests the gastro-intestinal tract as its site Pathologic diagnosis, secondary adeno-carcinoma of stomach, inoperable, mild chronic interstitial hepatitis

BIBLIOGRAPHY

- Graham, Evarts A, and Peterman, M G Further Observations on the Lymphatic Origin of Cholecystitis, Choledochitis and the Associated Pancreatitis Arch Surg, 1922, vol iv, p 23
- Hess v Volkmann's Sammlung klin Vortage, N F, 1900, No 576
- Heyd, Charles Gordon Physiology of the Extrahepatic Biliary System and Its Application to Surgical Therapy Transactions of the American Association of Obstetricians, Gynecologists and Abdominal Surgeons, vol xxxv, 1922, p 333
- Heyd, Charles Gordon Hepatitis Associated with, or Sequential to, Inflammatory Disease of the Abdomen Long Island Medical Journal, January, 1923

LIVER AND CHRONIC ABDOMINAL INFECTION

- Heyd, Charles Gordon Hepatitis, Cholelithiasis, Hydrops of Gall-bladder Surgical Clinics of North America, New York Number, 1923, Saunders and Co
- Heyd, Charles Gordon Hepatitis, An Associated Condition with Gall-bladder Disease Transactions of the American Gastro-enterological Association, 1923
- Heyd, Charles Gordon Hepatitis in Its Relation to Inflammatory Disease of the Abdomen Clinical and Laboratory Study Transactions of the American Association of Obstetricians, Gynecologists and Abdominal Surgeons, vol xxxvi, 1923
- MacCarty, W C, and Jackson, A The Relation of Hepatitis to Cholecystitis Minnesota Med, 1921, vol iv, p 377
- McMaster, P D, and Rous, P The Biliary Obstruction Required to Produce Jaundice Jour Exper Med, 1921, vol xxxiii, p 731
- Mann, F C Studies in the Physiology of the Liver Amer Jour Med Sc, vol clxi, p 37, 1921
- Mayo, Wm J The Surgical Significance of Hepatic Incompetency Surg, Gynec and Obst, 1921, vol xxxiii, p 463
- Mayo, Wm J The Liver and Its Cirrheses Jour A M A, vol lxx, 1918, p 1361
- Mayo, Wm J The Surgical Treatment of the Cirrheses of the Liver and Their Complications ANNALS OF SURGERY, vol lxxviii, p 183, 1918
- Peterman, M G, Priest, Walter S, Jr, and Graham, Evarts, A The Association of Hepatitis with Experimental Cholecystitis and Its Bearing on the Pathogenesis of Cholecystitis in the Human Arch Surg, 1921, vol xi, p 92
- Rous, P, and McMaster, P D Physiol Causes for Varied Character of Stasis Bile Jour Exper Med, 1921, vol xxxiv, p 75
- Stockton, C G Gastro-intestinal Infection in Relation to Infection of the Liver and Bile Passages Amer Jour Med Sc, April, 1922, vol clxiii, p 485

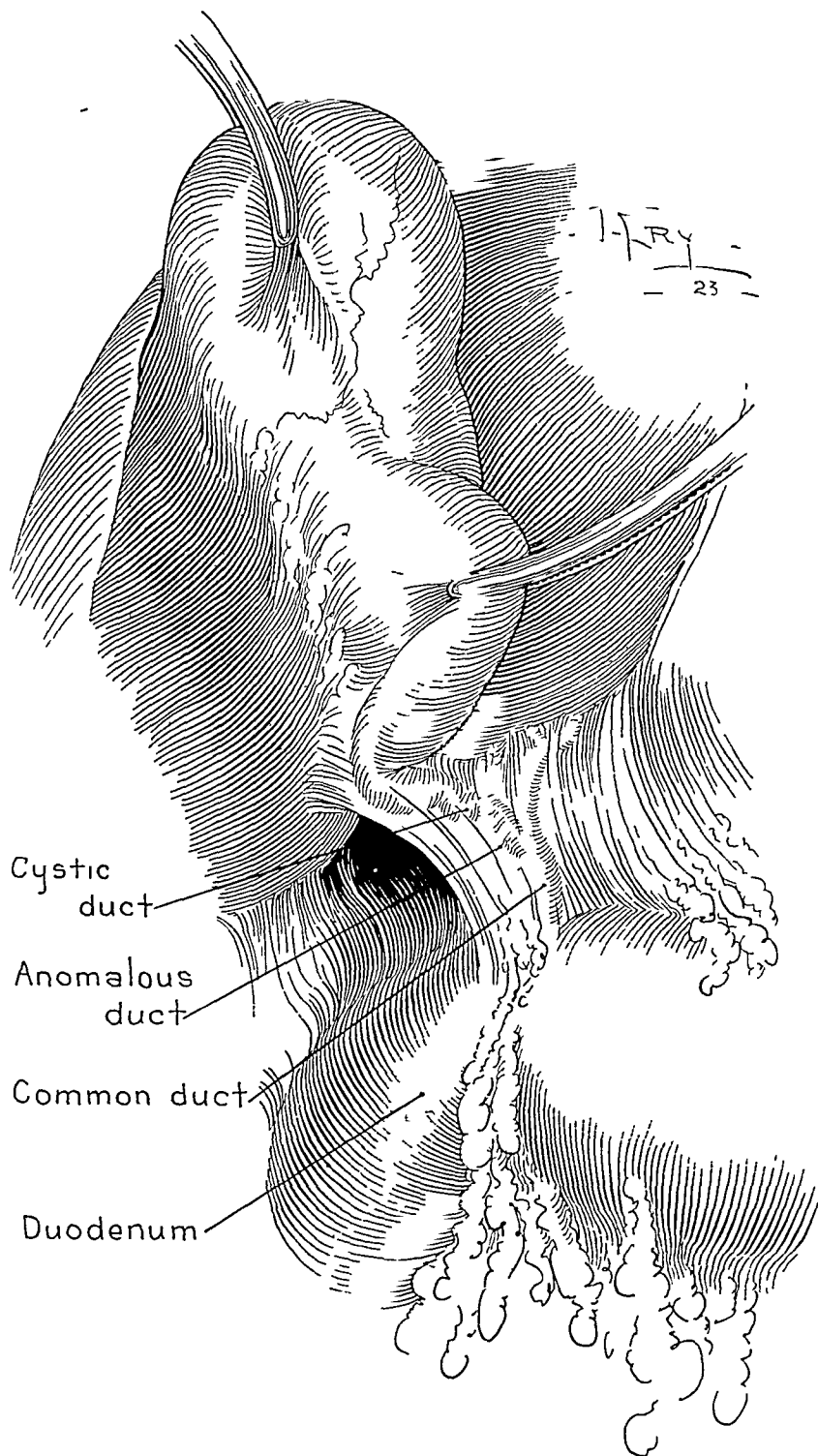


FIG 1—Anomalous hepatic duct

A METHOD OF RECONSTRUCTING AN ANOMALOUS HEPATIC DUCT INJURED AT OPERATION

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BECAUSE of the danger of injuring anomalous hepatic ducts during removal of the gall-bladder, the method is described which was used recently by C H Mayo of anastomosing the stump of the cystic duct to the cut end of an anomalous branch of the hepatic duct, which was injured when the gall-bladder was removed. If, in performing cholecystectomy, the method is used in which the cystic duct is first exposed and its union with the common

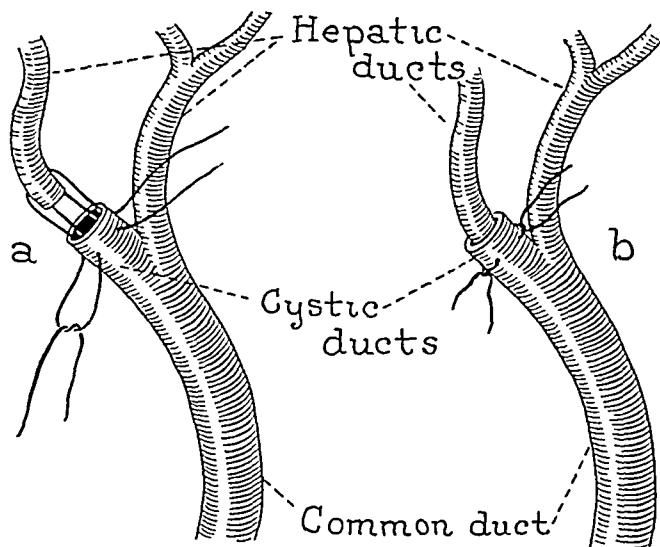


FIG 2 —a Sutures placed but not tightened b Hepatic duct telescoped into cystic duct and sutures tied

duct visualized, there is little danger of injuring a normal common or hepatic duct, unless there are small anomalous branches (Fig 1), in which case the anomalous duct may be severed with the cystic duct because of its proximity. Immediate recognition in this case made it possible to make the anastomosis. Sutures were introduced opposite each other into the stumps of the cystic and anomalous hepatic duct, as shown in Fig 2a, so that when the sutures were tied, the hepatic duct was telescoped into the remnant of the cystic duct (Fig 2b). A small portion of omentum was drawn up and placed in the liver notch, and two Penrose drains inserted in apposition, reaching down to the anastomosis. A small amount of bile drained from the wound for a few days, it then diminished gradually and the stools took on their normal brown color. The patient convalesced uneventfully.

RUPTURE OF THE SPLEEN

REPORT OF TWENTY CASES OBSERVED IN CHINA

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THAT rupture of the spleen is a frequent occurrence in the Orient is a common belief. We have considerable confirmatory information on the subject so far as India is concerned, but as yet little has been written on ruptured spleens in China. I reported two cases in the *China Medical Journal* in the January issue of 1917. I would like now to report twenty additional cases, all were treated in St Luke's Hospital, Shanghai, on my own surgical service and the service of Dr A W Tucker, who has kindly allowed me to report his cases.

While a number of writers have reported cases of spontaneous rupture of the spleen, it is interesting to note that all of our cases follow injuries. Not in my own experience nor in the experience of a number of my colleagues has spontaneous rupture been diagnosed. Such an accident must be rare, even in the most malarial districts of China. Many of the Chinese, for one reason or another, have very large spleens, and yet five of the most active surgeons in five different sections of China outside of Shanghai report, in answer to a questionnaire, that they have not seen a single case of rupture of the spleen, either accidental or spontaneous. All of these surgeons were working away from seaports. Price, of the Chinese Hospital, Shanghai, reported three ruptures during the past three years. It has occurred to the writer that possibly something about the work of the laborers in the seaports had to do with the increasing frequency in Shanghai. Does rupture of the spleen, even in countries where large spleens are common, only occur frequently where modern industry prevails? Answers to my questionnaire and my own experience would tend to confirm that belief.

In studying the etiology of our cases we find that 30 per cent were caused by tram or motor car accidents—instruments of slaughter not found in the interior of China.

To our surprise 50 per cent were the result of assault and battery. Why such encounters should prove so much more disastrous in Shanghai than up-country I can not explain, unless it be due to the fact that Shanghai is a cosmopolitan centre where personal combats are more frequently provoked and more fiercely contested.

Age—All of our cases were young, the oldest was thirty-nine and the youngest was ten, the average being twenty-four years. This is about the average age of patients admitted to St Luke's Hospital and is the age most exposed to hazardous occupations.

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Symptoms I have been surprised to find such a large number of our cases 50 per cent became unconscious at the time of the accident and remained so from a few minutes to several hours, this symptom is so frequently found that I consider it to be helpful in the making of a diagnosis "Pain radiating to the left shoulder" is mentioned by a number of writers on this subject, but has not been recorded in any of our cases, although definitely sought for in the last few Pain and tenderness over the left side were found to be, in our cases, the two most constant symptoms

Diagnosis from other abdominal injuries is frequently very difficult In one of our cases the marks of injury and the most prominent symptoms were all over the right side and this case was diagnosed as rupture of the liver A right rectus incision was made The liver was found to be uninjured but the spleen crushed Fortunately the pedicle was long enough for the injured organ to be removed through the original incision

Pathology In all cases operated on the spleen was found to be enlarged, in some instances to three or four times the normal size In two the malaria plasmodium was discovered History of previous attacks of malaria was given in a large percentage of cases

Treatment, Operative With our early cases the practice was to operate upon all, immediately it was decided that we were dealing with rupture of the spleen, provided, of course, that the consent of the patient or parents could be secured Two or three of those who refused operation recovered, and we were forced to believe that it was possible for certain cases of rupture of the spleen to recover without operation In later years certain cases presenting much shock have been allowed to rest before operating upon them Others with symptoms not so pronounced but still those of rupture of the spleen have been treated without any operation Our practice now is instead of operating on all cases just as soon as a diagnosis is made, each case is treated individually and the amount of shock and the condition of the blood and of the patient determines our line of treatment, whether to operate immediately, postpone operation until reaction from shock, or not to operate at all

Non-operative Whenever it is decided that a case is too much under shock for immediate operation, he is put to bed with blankets and hot water bottles, given a hypodermic of one-quarter morphine and warm saline solution by the Murphy drip method is begun and just as soon as the condition of the patient will permit, he is put up in the Fowler position Morphine helps to keep the patient quiet and lessens peristalsis, the Murphy drip supplies the body with additional liquid while the Fowler position causes the free blood to gravitate to the pelvis, where it will give the least trouble That position is also desirable because of the possibility of other organs having been injured

Results Obtained One patient refused operation and was removed from the hospital before any treatment was given Of the nineteen remaining for treatment, 58 per cent recovered and 42 per cent died Of the fatal cases only five had been operated upon Two of these died on the operating table, one within twenty-four hours, one on the fifth day after operation, probably

from embolus, and one at the end of two weeks from general peritonitis. It is interesting to note that most of these fatal cases were those having been injured by tram car or automobile accidents, or by a fall from the second or third floor.

Of the ten cases resulting from assault and battery, 80 per cent recovered, those resulting from tram car or automobile injuries, 50 per cent recovered, those due to fall, 100 per cent died, and one hit by an oar also died.

In reviewing our cases, I feel that with our first cases we operated when the condition of the patient was such as to make it almost a certainty that he would die. I believe now that a more careful consideration of the condition of shock would have caused us to be more cautious about immediate operation. One of our cases, Case XVI, came into the hospital and was given treatment and allowed to go away to be brought the next day in a dying condition. In one other case operation was probably postponed too long for the good of the patient. While a patient is under observation he should be nursed by a special nurse, his pulse recorded at least once an hour, the hæmoglobin estimated and blood-pressure taken frequently, and abdomen frequently palpated and percussed to elicit any changes there. With a decreasing hæmoglobin and blood-pressure and increasing thirst, with or without appearance of dulness in the flanks, operation should be strongly advised.

CASE I—S K S, age twenty-three Hospital No 2424 Admitted to St Luke's Hospital, November 3, 1917

Social and Past History—Unobtainable

Present Illness—The patient was run over by a motor car and was immediately brought to St Luke's Hospital. He gave symptoms of internal hemorrhage with considerable shock. Immediate operation was advised.

Under general anæsthetic the abdomen was opened by a left rectus abdominal incision. Upon opening the peritoneum a large amount of free blood gushed out. The spleen was found to be ruptured transversely. The pedicle was clamped and normal saline solution immediately given intravenously. Spleen was removed and the patient died on the table.

CASE II—T A H, age unknown Hospital No 2468 Admitted to St Luke's Hospital, November 10, 1917

Past History—Two weeks before admission to the hospital the patient fell down stairs, but was able to resume his work the following day.

Present Illness—One hour before admission to St Luke's Hospital he was run over by a motor car which crushed the costal margin.

Examination on Admission—The patient was in great shock. There was numbness and coldness over the body, slight pain over the splenic region. A diagnosis of ruptured spleen was made, and operation advised, which was refused by the mother and wife. Five hundred cc of normal saline solution were given intravenously and 2000 by the rectum and the patient treated for shock.

The patient died at 5 A M next morning.

CASE III—L Y S, age ten years Hospital No 3727 Admitted to St Luke's Hospital, July 6, 1918

Family, Social and Past History—Unknown

Present Illness—On the day of admission the patient fell down from a verandah

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on the second floor. He was unconscious for three or four minutes. Immediately after return to consciousness he complained of abdominal pain.

Examination on Admission—Patient is pale, he has a gash on the right forehead, but no sign of depression. Patient was conscious and answered rationally. Pupils react to light and accommodation. Restlessness and thirst were his chief complaints. The abdomen was rigid and tense. Pain was most intensive on left side and around the umbilicus. Percussion gave tympany on the surface and dulness in the flanks of the abdomen, especially on the left side. A diagnosis was made of internal hemorrhage with very probably, rupture of the spleen. His pulse ran as high as 160 per minute and was very small. Operation was advised but refused by the family.

The child was taken home against advice.

CASE IV—I K P, age thirty. Boatman. Hospital No 4901. Admitted to St Luke's Hospital, January 14, 1919.

Present Illness—On the day of admission while standing in his sampan his boat was struck by another sampan which caused him to fall, striking his left side on the side of the boat. He was unconscious for a short time and was immediately carried to St Luke's Hospital.

Physical Examination—Severe shock and only semi-conscious, pupils fully dilated and not reactive to light. His lips and conjunctivæ were anæmic. Pulse was rapid and weak. Palpation of abdomen found tenderness and rigidity on left side. The patient was put to bed with hot water bottles to react from the shocked condition. He reacted somewhat, but became more restless and the pulse more rapid and weaker and operation was advised and accepted.

Under ether and through a left rectus incision the abdomen was opened and the peritoneal cavity found to be full of free blood. The spleen was not very large and was ruptured in a number of places. The left kidney was loosened but not injured. Exploration of the abdomen revealed no other organ injured. The spleen was removed and the abdomen closed without drainage and the patient left the operating table in fair condition.

The next day the urine was tinged with blood, the general condition of the patient was fair, hæmoglobin 50 per cent. The patient improved for five days and was apparently in quite satisfactory condition at 10 P M on the fifth day. Early next morning he was found by the nurse in a dying condition and died before an interne could reach him.

No post-mortem was obtainable and the cause of death was thought due probably to embolism.

CASE V—Z W Z, age fourteen. Hospital No 6187. Admitted to St Luke's Hospital, August 13, 1919.

Family, Social and Past History—Not obtainable.

Present Illness—On the day of admission the patient jumped from a tram car and fell in front of an automobile, which was supposed to have run over him. He was immediately brought to St Luke's Hospital in very poor condition.

Examination on Admission—The patient was found to be very anæmic, extremities cold and covered with perspiration, the pulse was weak and rapid, respiration rapid and laborious, and percussion revealed dulness all over the abdomen.

The patient was put to bed in blankets and with hot water bottles and an ice bag applied to the abdomen. While waiting for operation the patient spat up a few drops of blood. The condition improved but little and at 7 30 P M, under an ether anæsthetic the abdomen was opened by median incision and the peritoneal cavity found to be full of free blood. The spleen was crushed into six pieces, the pedicle was clamped and vessels ligated. The spleen was removed. Exploration of the abdomen revealed no other injured or bleeding parts. The blood was removed from the peritoneal cavity and the abdomen filled with warm saline solution and closed.

Artificial respiration was performed but without good results At each time that air was expressed from respiratory cavity, blood was forced from the nostrils Cause of death was thought to be due to hemorrhage and shock

CASE VI—L F P, age thirty-nine Hospital No 7989 Admitted to St Luke's Hospital, May 23, 1920

Social History—Drinks and smokes moderately, denies specific disease

Past History—Has had no malaria or typhoid

Present Illness—At 2 30 P M the day of admission patient was assaulted and struck over the splenic area, which caused abdominal pain on the right side He was taken to his home and put to bed, but his color changed, and his pain grew worse so that he was brought to the hospital

Physical Examination on Admission—Patient looks weak, anæmic and exhausted, respiration hurried and slow The pulse is weak and rapid, 112 per minute Palpation shows rigidity and percussion, slight dulness over the splenic region The hæmoglobin was 70 per cent

The patient was put to bed and prepared for operation and eight and one-half hours after accident he was given a general anæsthetic and the abdomen opened by a left rectus incision through the upper abdomen Upon opening the peritoneal cavity considerable blood gushed out Exploration found the spleen to be ruptured, the pedicle was clamped and ligated with silk The spleen was removed and the abdomen flushed out with warm saline solution and closed without drainage The patient left the operating room in a bad condition Two pints of warm saline solution were given intravenously The next morning the patient complained of great thirst, pulse was good, 108 per minute, no sign of distention, and only slight pain in the wound The next day after the operation the hæmoglobin was 55 per cent, the white blood-cells 18,500, red blood-cells 4,800,000, lymphocytes 19 per cent, neutrophils 73 On the following day the hæmoglobin was 52 per cent, twelve days after the operation hæmoglobin was 58 per cent, white blood-cells 22,000 and the red blood-cells 4,400,000 No parasites were found in the blood The stitches were all removed on the eighth day and the wound was clean and dry

The patient made uneventful recovery, leaving the hospital on the twenty-fifth day in good health

CASE VII—L K N, age twelve Hospital No 8230 Admitted to St Luke's Hospital, July 2, 1920

Family, Social and Past History—Unimportant

Present Illness—Just before admission to the hospital, while running across the street, the patient was struck by a motor car and knocked down The wheel of the car struck his head, but did not go over the body

Physical Examination on Admission—There were abrasions around the head but no serious head injury Pulse a little quick but strong No rigidity or tenderness over the abdomen

The patient was put to bed for observation At 7 P M, a few hours after admission, the patient was found to be very anæmic and perspiring profusely Pulse was rapid and small and there was dulness over the right side but none over the left He complained of pain in the abdomen By 10 30 P M his hæmoglobin was 75 per cent and the systolic blood-pressure 70 per cent A diagnosis of internal hemorrhage with probable rupture of the liver was made and operation advised

Under ether anæsthetic the abdomen was opened by a right rectus incision and much dark blood was found in the peritoneal cavity The right side was first explored but no bleeding point found The liver was uninjured Upon examination the left side of spleen was found to be badly lacerated, one part being entirely separated The pedicle was clamped, ligated, and the spleen removed After flushing out the abdominal cavity with saline solution, the wound was closed by interrupted sutures

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The patient made an uneventful recovery, except on the fourteenth day when he began to have an attack of malaria

Pathological report on the spleen showed chronic fibrosis, congestion and hyperplasia of malpighian bodies

CASE VIII—W L P, age thirty-five Hospital No 8461 Admitted to St Luke's Hospital, August 1, 1920

Family, Social and Past History—Negative

Present Illness—Some days before admission a man with his fists struck the patient over the abdomen, causing some pain in that region The patient recovered in a day or so On the day of admission he again felt pain in the abdomen, especially on coughing

Physical Examination on Admission—The patient was anæmic and exhausted Pulse was feeble and rapid There was dulness in the flanks on both sides Immediate operation was advised and consented to

Under ether anæsthetic the abdomen was opened by a left rectus incision On opening the abdomen considerable free blood was found The left side was explored and the spleen found to be ruptured A splenectomy was performed and the patient made an uneventful recovery, leaving the hospital on the nineteenth day

CASE IX—S V K, age thirty-seven Bean curd seller Hospital No 8987 Admitted to St Luke's Hospital, October 8, 1920

Family, Social and Past History—Unimportant

Present Illness—On the night before admission the patient was tossed up by a number of his enemies and thrown flat on the ground, landing on his back This performance was repeated until the patient was unconscious He was immediately taken home, after which he regained consciousness He felt pain all over the abdomen He said that during the bumps he at first felt very dizzy and saw many flashes of light He had intense pain during the night with fever and profuse sweating

Physical Examination on Admission—Lips and conjunctiva pale, pulse rapid, 116 per minute, tenderness over entire abdomen, but more marked over left side Hæmoglobin 38 per cent, red blood-cells 2,860,000

Patient was put to bed and given morphia and Murphy drip He gradually regained his color and strength and left the hospital on the thirteenth day, apparently well

CASE X—Unknown, age unknown Hospital No 9942 Admitted to St Luke's Hospital, March 30, 1921

Family, Social and Past History—Not obtainable

Present Illness—About one hour before admission patient fell from a three-story window and was brought to the hospital in an unconscious condition

Physical Examination—Face very pale and distressed, pulse wiry, weak and rapid There was general tenderness over the entire abdomen, especially the splenic area

At 8 30 P M an exploratory laparotomy was performed On opening the peritoneum the abdomen was found full of blood and the spleen ruptured Splenectomy was done and 600 c c saline solution was given intravenously The patient left the table in very poor condition He was put to bed and Murphy drip ordered He did not rally and expired at 1 30 A M

CASE XI—L K K, age fifteen Hospital No 10251 Admitted to St Luke's Hospital, May 17, 1921

Family History—Unimportant

Social and Past History—Negative

Present Illness—At 8 A M on the day of admission, while quarrelling with a riksha coolie, patient received a blow on his abdomen in the left hypochondriac region The patient fell down and immediately became unconscious

Physical Examination on Admission—Patient is pale and anæmic, pupils are equal and reactive. On palpation the abdomen is rigid and tender, especially on the left side. Percussion gives a dull note in the flanks. On auscultation no gurgling sounds are heard over the left hypochondrium. The pulse is rapid and feeble. Operation was advised and permission secured. Operation begun at 9 30 A M. A six-inch incision was made through the right rectus muscle. Large amount of free blood found in the abdominal cavity. The spleen had a small rupture on the inner surface, bleeding had already ceased. No rupture of liver, intestines or kidneys was found. Since bleeding had already ceased the abdominal wall was closed by interrupted sutures without removal of the spleen. Two days later the patient complained of difficulty in urination and dulness was found over the supra-pubic region.

On the third day after operation patient vomited once, had a fecal odor. Abdomen is distended and tender, more marked over the right upper hypochondrium. Peritonitis was suspected and operation advised.

Under general anæsthetic the abdomen was opened by a straight incision in right lower quadrant. Considerable pinkish-colored discharge was found which had no odor of feces or urine. Two rubber tubes were inserted for drainage. The patient left the table in bad condition and died four days later from general peritonitis.

CASE XII—C K S, age twenty-four. Hospital No 11271. Admitted to St Luke's Hospital, October 2 1921.

Past History—Had malaria at sixteen years of age. No other history of importance.

Present Illness—On the day of admission, at about 10 A M, while the patient was pushing a wagon, a tram car knocked him down, the handle of the car striking the patient in the abdomen. The patient immediately became unconscious, but returned to consciousness after a very short time.

Physical Examination on Admission—Pulse weak and rapid, abdomen tender all over. Slight muscular rigidity. Abdomen was not distended and there was no dulness in the flanks. The patient was put to bed with hot water bottles and two grains of camphor ordered, given fourth hourly.

The next day the patient's color was not returning, pulse very weak, abdomen distended and dulness found in the flanks, very tender to touch, especially over the right iliac region. Breathing not much quickened but costal in type. There was no vomiting and no blood present in the stools, peristalsis still present. The rupture of the bowel was suspected. Hæmoglobin 55 per cent, white blood-cells 16,000. Patient was immediately prepared for exploratory operation. Under a general anæsthetic an incision was made through the right rectus. Upon opening the peritoneum the abdominal cavity was found to be full of dark bloody fluid. The hepatic region was first explored and the liver found to be normal. The intestines were delivered and a search made for rupture. No injury found. On palpating the spleen it was found to be enlarged and a rupture running across the surface palpated. The pedicle was grasped in the hand of the operator while his assistant made another incision on the left side. The spleen was removed and the abdomen closed as usual. The patient left the operating table in bad condition. He was put to bed and the Murphy drip begun.

The following day the pulse was much improved and the general condition of the patient satisfactory. On the following day the hæmoglobin was 60 per cent, white blood-cells 15,000. On the morning of the seventh day, after a very severe coughing spell, the dressing was found to be soaked with sanguineous fluid. On examination the silk-wrought stitch was found to be broken and the wound gaping.

The patient made an uneventful recovery, the stitches all being removed two weeks after the operation. On the following day the patient had a severe chill.

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followed by a high temperature. Blood examination showed hæmoglobin 65 per cent and the presence of tertian malaria parasites. Laboratory report of ruptured spleen showed fibrosis and hemorrhage in the splenic tissue. The patient left the hospital on the fortieth day.

CASE XIII—Z A P, age twenty-nine. Hospital No 11471. Admitted to St Luke's Hospital, November 2, 1921.

Family, Social and Past History—Negative.

Present Illness—At 7 A M in the morning on the day of admission, while quarrelling with others, the patient received a blow over the lower portion of the left side of the chest. Immediately he fell to the ground and was unconscious for about half an hour. When he returned to consciousness he felt keen pain in the abdomen which continued until after admission, and morphia was given. Upon admission he spat up a small amount of blood.

Physical Examination—Face and lips very anæmic, pulse weak but not rapid, 72 per minute. Abdomen shows some rigidity and slight tenderness over the splenic region, abdominal respiration present. No dulness in the flanks on percussion. He had a bruise area extending from the fifth rib to the costal margin on the left side. The spleen was not enlarged. The patient was put to bed in blankets and hot water bottles with a hypodermic of $\frac{1}{4}$ morphine.

In the afternoon the patient appeared to be better, the pulse improved. Next day there was still evidence of improvement with less tenderness over the splenic area. In the afternoon the patient complained of distention and pain in the abdomen and was quite restless. Examination of the abdomen showed slight distention, more over the left quadrant with increasing rigidity of the abdominal wall. No dulness could be percussed in the flanks and the pulse remained fair. The patient was put up in the Fowler position, $\frac{1}{4}$ grain of morphine and $\frac{1}{100}$ grain of atropine given hypodermically and turpentine stoops applied to the abdomen. The patient had a fairly comfortable night, but felt fulness in the abdomen on the following day.

The blood examination on the day after admission found 65 per cent hæmoglobin, 4,356,000 red blood-cells and no malarial parasites.

Ten days after admission hæmoglobin was 55 per cent, white blood-cells 14,000 and red blood-cells 2,168,000.

The patient continued to improve and left the hospital in good condition three weeks after admission.

CASE XIV—W S, age twenty-two. Hospital No 11562. Admitted to St Luke's Hospital, March 18, 1921.

Family, Social and Past History—Negative.

Present Illness—Just before admission, while in a fight, patient received two blows which struck against his hypochondriac region. He immediately felt pain all over the abdomen, but no nausea and no vomiting and only slight distention.

Examination on Admission.—Abdomen shows slight distention over epigastric region. Abdominal respiration present but not marked. Abdominal rigidity palpable more over the left upper quadrant of abdomen. Tenderness found over the same region, percussion shows slight dulness over left flank. No symptoms of anæmia, pulse 116. Operation was advised but refused.

The following morning the patient felt better, less pain, less tenderness and no signs of distention, pulse fair, 96 per minute.

Blood Examination—On the day of admission, hæmoglobin 80 per cent, on the day of discharge, 65 per cent.

The patient continued to improve and was discharged on the sixteenth day, feeling fairly comfortable.

CASE XV—O H, age twenty. Hospital No 12486. Admitted to St Luke's Hospital, May 1, 1922.

Family and Social History—Negative.

Past History—Three years ago patient had malaria Three days before admission noticed his feet and legs swollen and had nightsweats

Present Illness—About 12 30 P M, on the day of admission, patient received a kick over the left hypochondrium from a fellow worker Immediately he felt agonizing pain over the whole abdomen, especially over the left side

Physical Examination on Admission—Lungs and heart are negative with the exception that the pulse is rapid Examination of abdomen shows tenderness and rigidity, especially over the left side, with dulness over both flanks Operation was advised as diagnosis of ruptured intestines or spleen was made

Exploratory laparotomy was performed by an incision in the upper left rectus On opening the peritoneum a large amount of blood was found in the peritoneal cavity On examination of spleen a rupture of internal surface was found The external surface of the spleen was firmly bound to the abdominal wall by dense adhesions The rupture was packed with gauze, the abdominal wall closed, and the patient left the operating table in fair condition

On the next day the patient complained of general abdominal pain, especially over the hypochondrium On the fifth day after admission all the packing was removed On the ninth day a fair amount of chocolate-colored discharge came from the wound The stitches were all removed on the ninth day, considerable discharge from the wound, patient advised to lie on his stomach

Four weeks after the operation patient could walk about, wound fairly clean, less discharge The patient left the hospital advised to come back for daily dressings

CASE XVI—W Z F, age unknown Hospital No 12533 Admitted to St Luke's Hospital, May 10, 1922

Family, Social and Past History—Unobtainable

Present Illness—On the day before admission, while quarreling with a number of people, the patient received a number of blows over the head, causing contusion and several lacerations He was brought to St Luke's Hospital by the police The head injuries were treated and the patient allowed to leave the hospital, for he complained of no other injury The next morning at 9 A M he was brought back to the hospital complaining of severe abdominal pain, he appeared to be very sick, the radial pulse was very feeble He had great pain in the abdomen, conjunctivæ and lips were pale Breathing caused abdominal pain, but there was no great rigidity Dulness obtainable in the lower abdomen The patient was put to bed and given $\frac{1}{4}$ morphine and the Murphy drip begun

He died one hour later

CASE XVII—Z A S, age thirty-two Hospital No 12733 Admitted to St Luke's Hospital, June 7, 1922

Family, Social and Past History—Negative

Present Illness—Five hours before admission patient was knocked down by hand car He became unconscious immediately On recovery he felt pain in abdomen which was increased on respiration

Examination on Admission—At 3 15 P M patient is conscious but weak, drowsy, lips very anæmic, pulse weak and rapid, tenderness found over the left side of the chest, abdomen shows respiratory movement present, no rigidity palpable, slight tenderness found over the splenic region and slight dulness in the left flank

He was put to bed with hot water bottles and $\frac{1}{4}$ gram of morphine and 1/100 atropine given hypodermically and the Murphy drip started The next day the patient complained of pain in the abdomen, felt very thirsty and vomited after taking water More tenderness on the left side, rigidity found on palpation with more dulness over left flank The patient was put up in the Fowler position and

RUPTURE OF THE SPLEEN

the morphine and atropine continued Hæmoglobin 50 per cent Malaria parasites not found

Patient continued to improve and leaves hospital on the twenty-first day

CASE XVIII—W T C, age twenty Hospital No 12827 Admitted to St Luke's Hospital, June 21, 1922

Family and Social History—Negative

Past History—Five days before admission patient was assaulted and hit over the abdomen He did not feel pain immediately, but one hour later he began to have general abdominal pains He had no nausea, no vomiting, but felt thirsty on the third day after the injury Bowels moved daily Patient felt feverish last two days

Examination on Admission—Patient is weak, drowsy and exhausted, tongue coated, lips blue, pulse fair, 100 per minute, respiration quiet, slight tenderness over the left side of chest, tenderness all over the abdomen, most marked over the splenic region No marked dulness on percussion over the left flank Hæmoglobin 55 per cent, white blood-cells 11,500, red blood-cells 2,512,000

Patient is put to bed in Fowler position, Murphy drip begun, and ice bag applied to the splenic region

Patient made uneventful recovery, leaving the hospital at the end of the second week

CASE XIX—S C Z, age twenty-seven Hospital No 12926 Admitted to St Luke's Hospital, July 6, 1922

Family and Social History—Unimportant

Past History—He says he had no malaria but had daily fever about two years ago

Present Illness—One hour before admission in a fight patient received a blow over the left abdominal wall Soon afterwards he fell down unconscious and was immediately brought to St Luke's Hospital in great shock Patient was put to bed and $\frac{1}{6}$ morphine given and Murphy drip put on

Physical Examination before Operation—Patient looks anxious and complains of thirst Abdomen somewhat distended and on percussion dulness is marked over the splenic region and over both flanks Tentative diagnosis of ruptured spleen was made and operation advised

Under general anæsthetic a right rectus incision was made along the outer edge of the muscle Upon opening the peritoneum an amount of free blood was found The spleen was ruptured The pedicle was clamped and the organ removed and the abdomen closed by layer sutures Fifteen hundred c c of saline solution were given intravenously Blood examination before operation hæmoglobin 60 per cent, white blood-cells 22,600 Three days after operation, hæmoglobin 50 per cent, white blood-cells 15,000 Malarial parasites were not found in the spleen Stitches were removed on the tenth day and the patient allowed to sit up at the end of the second week and left the hospital in apparently good condition on the following day

CASE XX—L S, age thirty-six Hospital No 13236 Admitted to St Luke's Hospital, August 11, 1922

Family Social and Past History—Negative

Present Illness—About an hour before admission, the patient while loading a ship fell into the hold, landing on the left side of the body He was unconscious for a few minutes, but recovering consciousness felt pain in the left chest and abdomen He was brought to St Luke's Hospital at 3 P M

Physical Examination—Patient weak and exhausted, lips anæmic, hands cold and clammy, swelling noted over left side of chest with air crepitus on palpation Tenderness and crepitus found upon pressing over the third, fourth, sixth and

seventh ribs in mid-axillary line Abdomen not distended, respiratory movements limited, tenderness and rigidity found all over abdomen, more so on the left side Dulness on percussion over the left side

Patient was put to bed and given a hypodermic of $\frac{1}{4}$ morphine and the Murphy drip begun He passed away at 8 15 before the arrival of the chief of the department

Laboratory Report from a Partial Autopsy—Abdomen tense and distended, free blood found in the abdomen but no fecal matter Spleen though not enlarged was badly smashed, left kidney ruptured in two places, no perforation of the intestines The left lung was collapsed with escape of blood upon opening the diaphragm

CONCLUSIONS

(1) Rupture of the spleen in China is greatly increased by the coming in of modern civilization

(2) Immediate operation is not always demanded or advisable Great shock is a counter indication to immediate operation

(3) Usually splenectomy is the operation of choice but bleeding may be successfully stopped by packing when adhesions prevent the removal of the organ

(4) Great care is necessary to prevent injury to the tail of the pancreas

(5) The incision through the left rectus muscle gives good exposure and is usually all that is necessary

(6) In a country where large spleens are numerous, rupture of the spleen should be thought of in all cases of injury to the abdomen, followed by shock and evidence of hemorrhage

ACUTE PERFORATED ULCER OF THE STOMACH AND DUODENUM*

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THE proper procedure in the operative treatment of acute perforated ulcer of the stomach and duodenum is still a warmly debated question. Whether or not more should be done than simple closure is the main point in dispute. The opponents of more radical procedure—usually a gastro-enterostomy—offer as objections: First, It is unnecessary, perforation curing the ulcer. Second, It adds to the mortality. Third, There is danger of spreading infection in the peritoneal cavity. Fourth, It is not satisfactory in 100 per cent of the cases. Fifth, Re-perforation, hemorrhage, and stenosis are exceptional sequelæ. Sixth, The danger of subsequent jejunal ulcer. While, in reply, it is urged that: First, Perforation, alone, does not cure the ulcer in a large number of cases. Second, It does not affect the mortality in properly chosen cases. Third, The danger of spreading infection is of theoretical rather than practical importance. Fourth, While gastro-enterostomy is not always successful in relieving symptoms or preventing complications, it is so in such a large percentage of cases that there can be no longer any doubt of its specific effect. Fifth, Suture always narrows the lumen and the operation safeguards against secondary perforations and subsequent stenosis. Sixth, While subsequent jejunal ulcers are a possibility to be recognized, the incidence is extremely low.

Among the more recently reported series are Gibson's,¹ who, on the basis of sixty cases operated on at the New York Hospital, feels that closure alone is the operation of choice. Yet seven of his twenty-eight cases of duodenal perforation required secondary operation, though only one of twenty-eight recovered gastric cases needed further interference. Pool² comes to the conclusion that about one-third of the cases treated by closure alone develop later symptoms—usually pyloric obstruction, but feels that a definitely indicated gastro-enterostomy in these cases is better than a possibly unnecessary stoma at the original operation. Southam³ reports thirty-seven duodenal perforations, treated by simple closure, four of which, at secondary operation, showed chronic ulcer.

Smith⁴ reports forty-one duodenal ulcers, with simple closure, and four secondary operations. In Brenner's⁵ series of fifteen cases, all duodenal, three of twelve cases treated by closure alone (25 per cent) required further operative treatment. Stewart and Barber⁶ report twenty-four cases from the Third Division of Bellevue Hospital, in none of which was any operative procedure other than closure necessary.

* Read before The New York Surgical Society, October 10, 1923

On the other hand, Lewisohn⁷ as a result of study of his own cases and of a series of cases requiring secondary operation, feels that gastro-enterostomy should be done whenever possible, because of the possibility that the ulcer may persist. Deaver⁸ is strongly in favor of immediate gastro-enterostomy, feeling that if there is no shock or systemic toxemia before operation the mortality is not increased but may, on the contrary, be diminished. Cutler,⁹ reviewing a number of recent series, comes to the conclusion that gastro-enterostomy is advisable when the patient's condition warrants it.

Recently, Guthrie¹⁰ summarized the answers to a questionnaire on the subject of perforated duodenal ulcer. Of 150 surgeons replying, gastro-enterostomy (occasionally pyloroplasty) was done as a routine by twenty-two, by sixty-four, never, and by sixty-three, in a shifting percentage depending in varying degree on the condition of the patient, the size and induration of the ulcer and the degree of stenosis following closure.

Lately chiefly from Continental clinics reports of more radical procedures have been published. Hromada and Newman¹¹ report nineteen resections with fourteen recoveries. Paul,¹² from von Haberer's clinic, reports thirteen resections, with two deaths, and considers that follow-up reports show this to be a more satisfactory operation than closure, with or without a gastro-enterostomy, avoiding especially the danger of jejunal ulcer. Zoepffel¹³ reports twenty-three cases, with three deaths, and a mortality, during the period when resection was the operation of choice, of 21 per cent as compared with 56 per cent during the preceding five years. Noetzel¹⁴ and Brunner¹⁵ condemn this procedure as unnecessary and dangerous. At best it is possible only under unusual circumstances, with patients in good condition and in the hands of the most experienced operators, and in spite of the excellent reported figures the procedure should not be considered as a routine measure.

With surgical opinion still so divided, the report of individual hospital series seems justified, although, as Deaver points out, statistics are confusing, as early operation and skillful closure so overshadow all other considerations.

There have been twenty-five cases of acute perforation of gastric or duodenal ulcer treated on the first division of Bellevue Hospital, between October 1, 1919 and August 1, 1923. One case occurred in a woman of 43, the others in men in the following age groups:

20-30	7	40-50	6	60-70	1
30-40	7	50-60	3		

The extremes were 20 and 67 years.

Seven of ten patients with duodenal ulcer gave histories on which a working diagnosis of ulcer could have been made, one had lost weight for a year, while in two, perforation was the first evidence of disease. Of fifteen cases with gastric ulcer, seven had histories suggesting ulcer, five had had various types of indigestion, and, in three, perforation was without previous

warning Thus perforation was not preceded by symptoms of ulcer in the same percentage in both groups

When symptoms had been present, the average duration in the gastric cases (four years) was twice that of the duodenal group Medical treatment had repeatedly relieved the symptoms of seven patients One patient had been previously operated on for perforated duodenal ulcer, closure alone being done

The symptoms and signs of perforation have been so well and often described that it seems necessary to emphasize only certain points Vomiting occurred in 40 per cent of our duodenal cases, in 80 per cent of the gastric cases When present, it was an early symptom and rarely occurred more than once There was usually a conscious effort to prevent its repetition as it distinctly increased the pain

Gibson has recently called attention to the importance of a short-lasting pain in the left supraclavicular fossa, which he feels to be a very characteristic symptom We however, have failed to elicit it in our recent cases

Obliteration of liver dulness is a sign, the value of which is under discussion We have felt satisfied of the absence of dulness in nine cases in which we did not feel that we could ascribe the change to distention

Shock occupies an important place in the literature as a symptom of perforation It is usually described as short-lived and followed by a free interval before the development of signs of peritonitis Deaver speaks of it as probably common but not often seen, and says that apathy, rapid feeble pulse and low blood-pressure are rare Brenner, in his review of fifteen personal cases, came to the conclusion that it was over-emphasized, finding it a factor in only one-fourth of his series We have had the unusual experience of having four cases perforate under observation Three of them had been admitted as ulcer, one for another condition In none of the four had there been any recent change in the variety or intensity of the symptoms One case perforated shortly after an examination by a group of students, twenty-four and forty-eight hours after a fluoroscopic examination with bismuth In one of the four cases, perforation was preceded by a massive hemorrhage, as a result of which there was extreme shock and ultimate death, without operation In the remaining three, operation revealed perforations with no attempt at closure and wide-spread contamination of the peritoneal cavity In none of these was there any evidence of shock, the pulse not changing appreciably in rate or force, while the blood-pressure remained unaffected There was no evidence of mental apathy, this being particularly true of one patient who had previously perforated The man made his own diagnosis and was insistent on early operative relief Shock was noted as being present in only one of the cases admitted shortly after perforation It may, however, have been a factor in the poor behavior under anæsthesia noted in two others

Pathology In ten duodenal cases, the perforation was, in all cases, on the anterior surface or upper border of the first part of the duodenum The lesions were of two distinct types There were four cases in which a clean-cut

perforation of 3 or 4 mm in diameter was surrounded by normal, or at the most, a slightly cedematous duodenal wall. In six others, a perforation of about the same size lay at the centre of an area of infiltration which was usually 1.5 cm in diameter, although in one case measuring 2.5 cm across. Wilensky¹⁰ suggested that the acute perforation without surrounding infiltration might be embolic in origin, without previous disturbance of the physiology of the stomach or duodenum and therefore no impairment of function after simple repair unless a secondary ulcer developed about the site of perforation, while perforation in the second group was part of the biological phenomena of ulcer, with disturbance of intestinal function perhaps requiring more radical procedure, though not necessarily at the primary operation.

Brenner felt that the infiltration in the second group was protective in character and soon disappeared, following closure of the perforation. In his series the soft, non-callous ulcer predominated, and he believed it to be the more common type of perforating duodenal ulcer. It is our experience that the infiltration is part of the ulcer process and that it will persist following a closure of the perforation, with persistence or recurrence of symptoms.

In line with Wilensky's suggestion, we felt that the non-callous perforation might have a shorter history than the callous ulcer, or might even present perforation as the first symptom of disease. This has not been the case, however, only one non-callous ulcer perforating without previous symptoms, while, in three, ulcer pain dated back over one, five, and ten years, respectively. It may be that in these cases the entire indurated area sloughed away, but, unless this is the case, there is no apparent connection between the type of ulcer and the duration of symptoms.

Of fifteen gastric perforations, nine were at or near the pylorus, while six were in the body of the stomach. Of the former, two may have been duodenal, as they were exactly over the pyloric ring, with an obliterated pyloric vein which could not be identified. These ulcers were, in general, considerably larger than the duodenal, with a more extensive area of infiltration about the perforation. In only three of the fifteen was there no infiltration about perforations measuring from 2 to 10 mm in diameter. As in the duodenal cases, these three presented ulcer histories of from four to twelve years' duration.

In three cases, all duodenal, the perforation was sealed by omentum at the time of operation. In these cases there had been a minimal amount of leakage, and the patients might well have recovered without operation. The appearance of the ulcer, with its adherent omentum, bore a striking resemblance to that seen in several patients operated on as interval cases, and suggests that in the latter there might have been at some time a perforation so rapidly sealed off that the patient thought only of an unusually severe attack of ulcer pain.

The peritoneal reaction varied, in degree and extent, with the size and location of the perforation, the delay in operation, and the contents of the stomach (either present at the time of perforation or added later for the relief

ACUTE PERFORATED ULCER OF THE STOMACH

of pain) It extended from small amounts of fibrin, practically no fluid and a normal peritoneum in the case of a small perforation already sealed off, through large quantities of fibrin with solid food particles and, in two cases, castor oil, to the exudate of a diffuse peritoneal infection

Bacteriology There is little agreement as to the bacteriological findings in early cases of perforation Deaver reports twenty-three sterile cultures out of thirty-four taken Stewart and Barber say that the colon bacillus is usually recovered, in one of their cases six hours after perforation Brenner, in his fifteen cases, had eleven negative cultures Pradel¹⁷ found negative cultures in four of ten early cases, and considers that sterility might be due to the acidity of the stomach contents checking bacterial growth until in later hours it is converted to an alkaline medium Gibson implies that early positive cultures are uncommon, and quotes E G Alexander of Philadelphia, as saying that he has never obtained a growth within the first eighteen hours

Cultures were taken and reported in ten of the early cases, four gastric, six duodenal Only one of the gastric cases was sterile, while four of the six duodenal cultures were negative The cultures, with the time elapsed and their relation to wound healing, were as follows

Gastric

Duration	Growth	Wound healing
4 hours	Sterile	Primary union
7 hours	Staphylococcus albus	Primary union
8 hours	Hæmolytic staph albus	Abdominal wall infection
10 hours	Streptococcus viridans	Acute, diffuse peritonitis, death

Duodenal

Duration	Growth	Wound healing
3 hours	B Coli communis	Primary union
4 hours	Sterile	Abdominal wall infection
6 hours	Sterile	Primary union
7 hours	Sterile	Primary union
7 hours	Non-hæmolytic strept	Abdominal wall infection
9 hours	Sterile	Primary union

Operation and Mortality Operation was performed in all but one unrecognized case In this case perforation was preceded forty-eight hours by a massive hemorrhage and was accompanied by a second severe hemorrhage, with death in three hours Death was thought to be due directly to the hemorrhage until autopsy revealed a perforated ulcer of the pyloric region In three cases, a refusal to operate might have been justified, as the patients were in serious or moribund condition, dying within six hours of operation Even in these, however, it seemed fair to give the patient the benefit of peritoneal drainage, under local anæsthesia, in one case, with no attempt to locate or close the perforation

There were, in all, seven deaths, a mortality rate of 28 per cent As in

all reported series, the time factor is of primary importance in the mortality, our operative deaths being classified as follows

Under 12 hours	17 cases	1 death	6 per cent
13 to 24 hours	5 cases	3 deaths	60 per cent
48 hours, or more	2 cases	2 deaths	100 per cent

One case died without operation, primarily as the result of hemorrhage

The duodenal mortality was one in ten cases, the gastric, six in fifteen, 10 per cent and 40 per cent, respectively. In general, gastric cases seem to have a higher mortality, for instance, Gibson's figures of 12 per cent and 21 per cent, respectively. Occasional series reverse these figures, thus, Schulein,¹⁸ reporting from Hochenegg's Clinic, has a duodenal mortality of 53 per cent, gastric, 33 per cent, and considers that the duodenal contents may be of greater infectivity, a conclusion not borne out by our bacteriological reports. Our figures are of no value in this connection as the time element is a predominating factor, five of the six gastric deaths being in cases of over thirteen hours' duration, the sixth, a non-operative death.

Procedure Closure of the perforation has been the first step in all but one case—a man in desperate condition, in whom a pelvic peritoneal drainage was performed under local anæsthesia, with no attempt to locate or close the perforation, which autopsy showed to be duodenal. In the nine remaining duodenal ulcers, closure alone was performed in five cases, closure and gastro-enterostomy in four. The indications for gastro-enterostomy, in our minds, have been. First, the good condition of the patient, second, the presence of infiltration of the duodenal wall extending well beyond the limit of the perforation, third, and of least importance, apparent stenosis as a result of the closure of the perforation. In three cases, closure alone seemed sufficient because of the absence of infiltration about the perforation, in two, gastro-enterostomy would have been performed but was postponed because of the patient's condition. In both of these there was a considerable degree of infiltration of the duodenal wall. One case was a re-perforation at the original site, the first operation being a duodenorrhaphy.

Re-operation has been necessary in three of the five cases treated by closure alone, in one case for obstruction, in two non-infiltrated cases, for persistence of ulcer symptoms. In both these, extensive areas of infiltration were found at the second operation. The remaining two—one a callous ulcer, the other, non-infiltrated—are well at present, both less than a year after operation.

Of nine pyloric ulcers, eight came to operation. Immediate gastro-enterostomy was done in two cases, both of which may well have been duodenal in origin. In both of these the pylorus was occluded by the closure. The remaining six were treated by closure alone. Three died, all late cases. Of the remaining three, one was well when lost sight of, six months after operation, one has had a secondary operation, a gastro-enterostomy for obstruction, and the third has persistent ulcer symptoms with X-ray findings indicative either of ulcer or of deformity following operation.

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Six ulcers of the body of the stomach have been treated by closure alone. Four recovered and have required no further interference.

Thus, of eighteen recovered cases, four (22 per cent) have required secondary operation. They were all in what has been called the para-pyloric group, of which they form 30 per cent. Of the duodenal cases, three out of five treated by simple closure (60 per cent) have required secondary operation.

Drainage is still a debated question, although apparently the tendency is away from it. Of one hundred and thirty-seven men answering this question in Guthrie's questionnaire, one hundred and one drained "always", five, "usually". Winslow¹⁹ drained all but one of his twenty-nine cases, one-half of which, however, were over the twelve-hour limit. Stewart and Barber omitted drainage in only one of their cases. Souther²⁰ always drains the pelvis. On the other hand, Biennet considers it necessary only occasionally to drain the abdominal wall. Southam uses it rarely only in cases of over eighteen hours' duration, and then through a suprapubic stab-wound. Smith closes after irrigation through a suprapubic stab-wound. Paul considers drainage necessary only if there is necrotic tissue or uncontrollable bleeding. Piader considers drainage inadvisable in early cases, Gibson feels that it is rarely necessary, and then, perhaps only in the later cases, Stillman feels that it is unnecessary if the perforation has been properly closed and the peritoneum cleaned by suction.

We are employing it in early cases with steadily diminishing frequency at present, as a rule, limiting drainage to the abdominal wall and employing it only when there has been extensive peritoneal soiling, with resulting contamination of the abdominal incision. Our results have been as follows:

Cases closed without drainage	10
Primary union	6
Wound infection	3
Peritonitis	1
Cases closed with drainage	7
Union without infection	5
Wound infection	2

All the late cases have been drained.

Complications — Pneumonia	6, 2 deaths
Bronchitis	1
Parotid sialadenitis	1
Gastric fistula	1, 1 death

The gastric fistula occurred in a large ulcer in which the closure of the perforation was difficult and unsatisfactory. If this case had come to operation early, rather than after twenty-four hours, resection might have been advisable, as the ulcer was near the pylorus, and resection would not have been a difficult procedure. It was not considered as peritonitis was already established. Gastrostomy has occasionally been done in cases of this type, but with poor results.

Follow-up Fifteen cases have been followed from one to four years. One other was lost track of after six months and there have been two recent cases which have been followed for less than a year. The results may be summarized as follows:

Duodenal Ulcer —Closure and Gastro-enterostomy

3 cases	symptom free	17, 18, 19 months
1 case	occasional eructations	18 months

Closure, Secondary Gastro-enterostomy

3 cases	symptom free	18, 28, 33 months
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Closure

2 cases	symptom free	2, 8 months
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Pyloric Ulcer —Closure and Gastro-enterostomy

1 case	symptom free	45 months
1 case	eructation after heavy meal	31 months

Closure, Secondary Gastro-enterostomy

1 case	epigastric pain with no relation to meals	12 months
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Closure

1 case	symptom free	6 months	(Lost track of)
1 case	ulcer symptoms	24 months	

Gastric Ulcer —Closure

3 cases	symptom free	22, 38, 48 months
1 case	epigastric pain after meals, relief following operation for perigastric adhesions	18 months

Resume —In this series of twenty-five cases, shock has been an unimportant factor. It was not present in three of four cases perforating under observation.

Immediate gastro-enterostomy has not affected the mortality, there having been no deaths in the cases in which this operation was performed.

Intra-peritoneal drainage is rarely necessary in early cases.

The most satisfactory results to date have been in the duodenal group with gastro-enterostomy either primary or delayed. Six of seven cases treated this way are symptom-free, the remaining one improved.

Ulcers of the body of the stomach treated by single closure have also given satisfactory results.

The pyloric ulcers have been the least satisfactory, only one of four patients followed over a year being symptom-free.

Operative stenosis can be disregarded as an indication for gastro-enterostomy, unless complete.

Gastro-enterostomy is indicated in perforated duodenal ulcer, with surrounding infiltration, provided the patient's condition permits the additional time necessary for that procedure. In the perforated ulcer without infiltration closure alone may be adequate, and gastro-enterostomy should be postponed.

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REFERENCES

- ¹ Gibson, C E Amer Jour Med Sc, vol clv, p 809, June, 1923
- ² Pool, E H ANNALS OF SURGERY, vol lxxvi, p 457, Oct, 1922
- ³ Southam, A H Brit Med Jour, vol 1, p 556, April 8, 1922
- ⁴ Smith, F H Brit Med Jour, vol 11, p 1068, December 24, 1921
- ⁵ Brenner, E C Surg, Gyn & Obstet, vol lxxiv, p 370, March, 1922
- ⁶ Stewart, G D, and Barber, W H ANNALS OF SURGERY, vol lxxv, p 349, March, 1922
- ⁷ Lewisohn, R ANNALS OF SURGERY, vol lxxii, p 595, November, 1920
- ⁸ Deaver, J B ANNALS OF SURGERY, vol lxxiii, p 441, April, 1921
- ⁹ Cutler, E C, and Newton, F C Boston Med & Surg Jour, vol clxxxviii, p 789, May 24, 1923
- ¹⁰ Guthrie, D N Y State Jour Med, vol xliii, p 66, February, 1923
- ¹¹ Hromada, G, and Newman, S S Surg, Gyn & Obstet, vol lxxv, p 11, July, 1922
- ¹² Paul, E Deutsche Zeitschr f Chir, vol clxxii, p 94, 1922
- ¹³ Zoepffel, H Zentralbl f Chir, vol xli, p 1895, December 23, 1922
- ¹⁴ Noctzel, W Deutsche Zeitschr f Chir, vol clvii, p 116, November, 1921
- ¹⁵ Brunner, T Munch med Wchenschr, vol lxi, p 77, January 20, 1922
- ¹⁶ Wilensky, A O ANNALS OF SURGERY, vol lxxvi, p 38, July, 1922
- ¹⁷ Prader, J Arch f Klin Chir, vol cx, p 758, October 28, 1922
- ¹⁸ Schulem, M Deutsche Zeitschr f Chir, vol clvi, p 242, March, 1921
- ¹⁹ Souther, C T Ohio State Med Jour, vol xlvii, p 605, September, 1921
- ²⁰ Winslow, N ANNALS OF SURGERY, vol lxxiv, p 721, December, 1921

ASEPTIC TECHNIC FOR THE RESECTION OF INTESTINE

REPORT OF THREE ADDITIONAL CASES

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IN APRIL, 1887, the late Doctor Halsted read a paper before the Harvard Medical School, entitled "Circular Suture of the Intestine" This paper was the result of a series of experiments on the dog, and introduced the quilt or mattress suture in intestinal surgery A further report of this work was made before the Medical Society of the Johns Hopkins Hospital in December, 1890 This with the work of Senn was the beginning of modern intestinal surgery Too much credit cannot be given these men whose pioneer work will always be used as references

Before the Section on Surgery, of the meeting of the American Medical Association in June, 1908, Dr Frank B Walker reported a method of end to end anastomosis of the intestine To him should be given the credit of the first attempt to use the purse-string suture to make the bulkhead end to end anastomosis aseptic Gatch, in 1912, reported a method in which the two ends of severed gut was held by clamps and the gut sutured by Cushing right-angled sutures

More recently, Collins, Highsmith, Trublood, Halsted, Foley and Bidgood have described various methods of aseptic gut resections

I merely mention the above historical data because of the interest that has been recently aroused, in men working on this problem from various parts of the country, as well as to call to attention several historical errors that have been made in the report of the work of several men

In discussion I should say that the methods of Walker, Moschkowecz, Parker and Kerr, and Warbasse are practically the same The methods of Gatch and Shoemaker are very similar The methods of Bidgood and Highsmith are of the same principle and necessitate a special instrument The technic used by Collins is a combination of the methods of Gatch and Walker in that he uses a purse-string and a clamp to hold the two ends of the severed gut In the method of Grey the technic is broken in introducing plugs of fibrin into the lumen of the gut

In the method described by the author in the original article, the only point of contamination as in any other purse-string method might be in contaminating the wound by putting the needle into the lumen of the gut It was shown by Gatch that the use of the cautery in cutting the gut across was sufficient to produce a field sterile in a series of cases in which negative cultures were obtained The advantages in this method are, first, no mechanical appliances are necessary Second, the purse-string suture remains in the gut in the event that the bowel was punctured in placing the suture Third, every step of the operation is carried on from without, nothing being introduced into the

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lumen of the gut Fourth, less time required than the ordinary methods Fifth, the operation is entirely completed before the lumen is opened, as it is not necessary to put in any more sutures after the lumen has been restored Sixth, both ends of the severed gut can be opened simultaneously so that the contents of one end will not contaminate the knot of the purse-string of the corresponding side

In addition to the two cases reported in my preliminary article, I wish to add three more cases

First—D J, man aged fifty-six, carcinoma of the sigmoid, operated by Doctor Holland and myself Twenty-four hours after operation, passed fecal matter by rectal tube Six days after, developed fecal fistula through which he passed some cherry seeds Patient died on the eleventh day Autopsy showed a fecal fistula from a loop of small gut that was adherent to the carcinoma of the sigmoid at the time of operation It was a question then whether to resect this portion of gut or not Diffuse peritonitis The site of anastomosis was intact No leakage Cause of death, peritonitis from fecal fistula in small gut Incidentally as a matter of interest there was a quantity of cherry seeds impacted proximal to the fecal fistula

Second—This patient was operated by Dr Hugh Trout of Roanoke, Va In a personal communication he states he has used this method successfully

Third—This man was operated by Dr Arthur M Shipley W P, a colored man, twenty-four years of age, with an acute obstruction was admitted to his service and operated A mass was found in the splenic flexure of the colon, which later proved to be carcinoma by pathological report from Doctor Spencer A cæcostomy was done and a resection by this method done three weeks later through a left transverse incision Thirty-six hours after operation, expelled some gas per rectum Three days after operation, normal bowel movement Cæcostomy wound still functioning Four weeks after resection cæcostomy was closed Patient has been having normal bowel movement daily No evidence of hemorrhage at any time Eight weeks patient returns to the dispensary all wounds healed Before discharge from the hospital a gastro-intestinal series made and a bismuth enema given There was no obstruction, the bismuth passing up the descending, transverse and ascending colon into the lower ileum

REFERENCES

- Halsted Am J M Sc, 1887, vol xciv, p 436
Halsted Bull J H U, 1891, vol ii, p 1
Senn J A M A, 1893, vol xxi, p 215
Parker and Kerr Bull J H U, vol xix, p 132
Gatch J A M A, 1912, vol lix, p 185
Walker J A M A, 1908, vol li, p 546
Shoemaker Surg, Gyn Obs, 1921, vol xxxiii, p 541
Moschkowecz Wein Klin Wchnschr, 1909, vol xxii p 818
Warbasse Surg Treat, vol ii, p 657
Halsted ANNALS OF SURGERY, 1922, vol lxxv, p 356
Collins ANNALS OF SURGERY, 1922, vol lxxvi, p 739
Horine ANNALS OF SURGERY, 1922, vol lxxvi, p 745
Grey Bull J H U, 1912, vol xxi, p 267
Foley Surg, Gyn Obs, 1923, vol xxxvi, p 836
Trublood Northwest Med, 1923, vol xx, p 27
Bidgood Bull J H U, 1923, vol lxxiv, p 197
Highsmith Surg Gyn Obs, 1923, vol xxxvi, p 271

UTERUS DIDELPHYS

NOTES ON ITS DEVELOPMENTAL ETIOLOGY

AND ITS CLINICAL SIGNIFICANCE

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It is natural that any organ of the body which has such a complicated development as that shown by the uterus and vagina should reveal anatomical variations from the normal. It is not at all surprising that such anomalies should be unnoticed during childhood, inasmuch as their function does not commence until the end of this period, but that a person can pass through adult life, successfully fulfilling the obligations attendant on raising a family in spite of such a handicap, without the anomaly being discovered, lends considerable interest to a condition which after all is not uncommon.

The following case,* upon which an operation was performed for reasons other than the anatomical variation, resulted in so interesting a specimen and gave such an unusual history that our interest was stimulated to further inquiries regarding the condition. The cases subsequently found complete the picture of an interesting clinical condition.

CASE I—P B B H, Surgical No 17687 Admission of Louise F, a married, white, American housewife, age thirty-four, complaining of "falling of the womb."

Family History—Interesting in that her mother has three breasts. One of her brothers was born "with all his organs inside." He lived only three days. As nearly as can be determined, the patient means that at autopsy, penis, scrotum, and testicles were intra-abdominal.

Past History—Always healthy and vigorous with good habits. Married six years. There have been four pregnancies. The first one terminated in a miscarriage at three and one-half months. The second occurred a year later. There was a twelve to fourteen-hour labor, ending after instrumental intervention in a still-birth, breech presentation. A severe laceration was repaired at this time. One year after this her third pregnancy ended at seven and one-half months. There was a short and comparatively easy labor though this was also a breech case. The child is living and well to-day. One year before admission, her fourth gestation terminated at full term in a normal healthy living child.

She had never been told by any of the various persons who attended her at these times that there was anything abnormal or unusual about her pelvic organs. It seems certain therefore that the condition was unrecognized.

There has been nothing out of the way about the marital relation to attract either her's or her husband's attention.

Her catamenia began at fourteen years of age and have been painless and regular until interrupted by her pregnancies. There has been a profuse leucorrhœa most of the time since her periods began.

Present Illness—Ever since her second pregnancy she has had dragging pain in the pelvis, accentuated at the time of her periods, and accompanied by backache.

* From the Surgical Clinic of the Peter Bent Brigham Hospital, Boston, Mass.

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and headache During the last two years she has been nervous and irritable and has felt something protruding from the vulva when she was standing The sense of pelvic pressure and backache has been much worse during this time Frequency at half-hour periods when on her feet has also been present She has felt tired most of the time Her last regular period was completed two months before entry to the hospital

Physical Examination—The general physical examination was quite negative except for the local findings The patient was well developed and appeared healthy and normal in every other way Our attention naturally focussed on the pelvic condition and in the light of subsequent findings it is interesting to record in detail

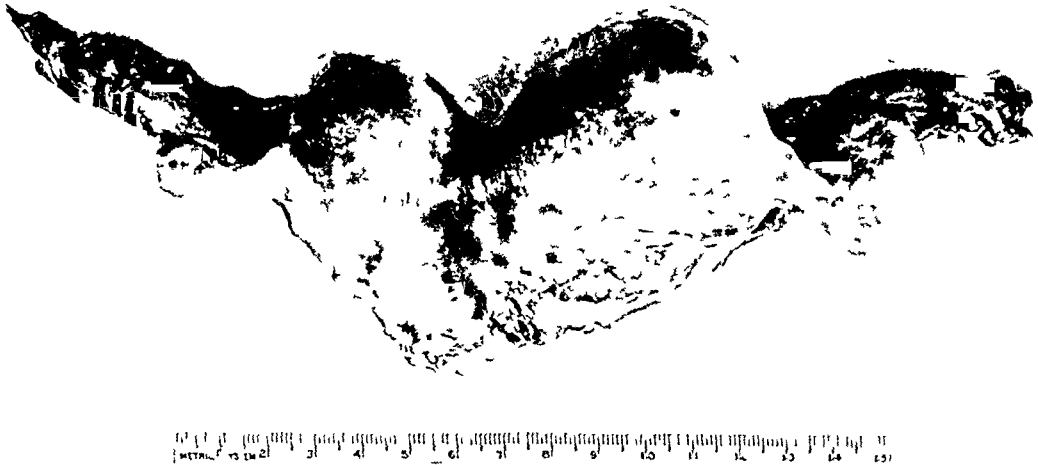


FIG 1—Case I Didelphic uterus, tubes and ovaries Antero-posterior view of fresh specimen

the note of the examination made before the patient was taken to the operating room It reads "Introitus marital, color normal, evident muco-purulent discharge Protruding from the labium majoro is a soft, pinkish, non-tender, reducible mass, which seems to be an unusually redundant fold of the anterior vaginal wall Slight rectocele Cervix comes well down to just outside the vestibule when the patient strains, is of normal size, color and consistency, and shows a small stellate laceration Uterus of normal size, freely movable, and in third degree retroversion It is difficult to outline the uterus because of the depth of the pelvis No tenderness or masses in either vault Adnexa not palpated Perineal body small and thinned out"

Rectal examination added nothing

A diagnosis of prolapse was made and operation advised

November 6, 1922 Operation Ether Examination Supravaginal Hysterectomy for Prolapse Fixation of Cervical Stump (Didelphic Uterus) Under ether anæsthesia a careful pelvic examination was done with the following findings

The fold of the anterior vaginal wall, believed at the time of previous examination to be a cystocele with a large redundant fold as a result of obstetrical

repair, proved to be a complete septum running from the anterior to the posterior vaginal wall. This fold could be pushed to either side with ease, revealing two vaginal canals at the upper end of each of which there was a normal cervix. These were alike in size, and had similar lacerations of a stellate character. Both the cystocele and rectocele proper were moderate in degree. A uterine probe was passed into both cervixes without obstruction, deviating to the right and to the left, respectively. At no point could a communication be made out between the two canals. The left uterine cavity was slightly deeper than the right. Traction on either cervix showed the double uterus to be very freely movable. Both could be delivered outside the labia for a distance of two centimetres. When one cervix was

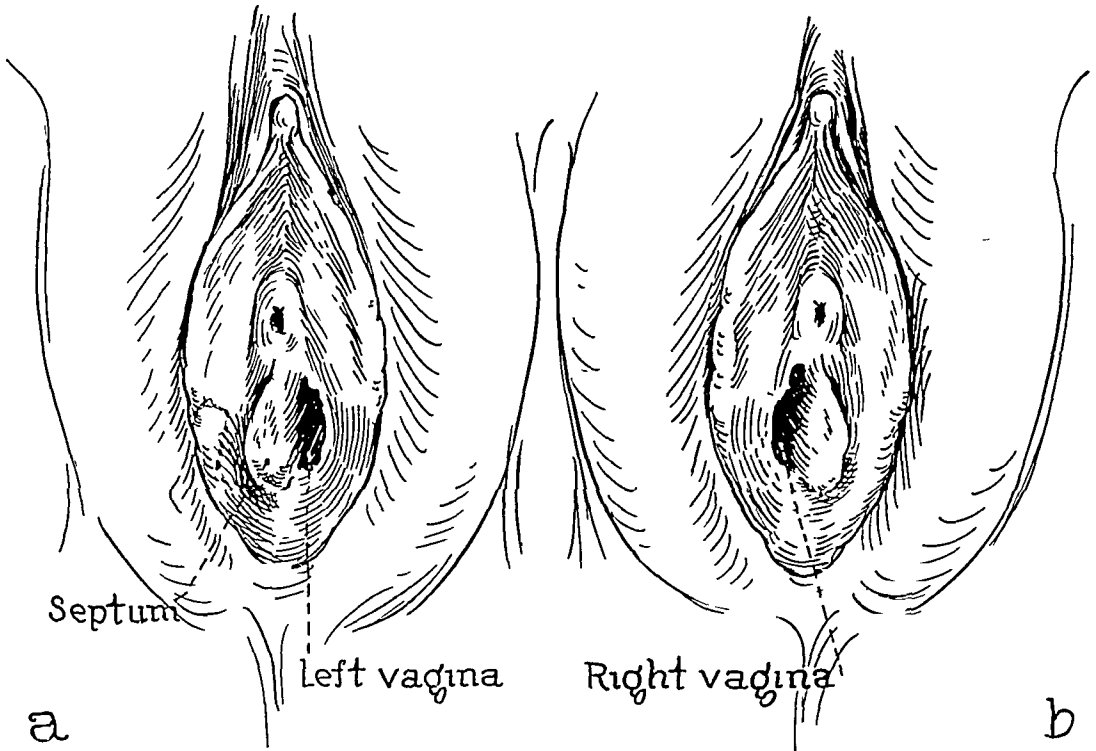


FIG 2—Case I Drawing of external genitalia illustrating the attachments of the vaginal septum

being examined it was not possible to see the other, the redundant septum appearing to be only the lateral wall of the vagina.

No plastic operation was done below in view of these findings, the abdominal operation being relied on for relief of the prolapse.

Examination of the pelvis above through the usual midline suprapubic incision revealed a double uterus, with one tube and ovary attached to each outer cornua, the two fundi joining at about the level of the internal os of the cervix. The left uterus was nearly as large again as the right one, and was somewhat soft. The left ovary was at least three times bigger than the right one and had a definite corpus luteum. Inasmuch as hysterectomy had been advised and agreed to by the patient, and also because it was thought probable that pregnancy had been interfered with by the probing below, the uterus and adnexa were removed. When the cervix was cut across it was again demonstrated that the two cervical canals were perfectly intact, communicating nowhere with each other. The cervical stump was fixed to the anterior abdominal wall and the abdomen closed.

Recovery was uneventful. The wound healed perfectly. She was discharged November 24, 1922, twenty-one days after operation, and at the time of this writing (ten months later) reports herself well and happy, entirely relieved of symptoms.

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Pathological Note—(The specimen was at once cut in a plane parallel to the cervical and uterine canals See Fig 5)

The uterus is divided by a septum into two portions, the septum running from the fundus down through the cervix to the point of amputation As the septum runs upward between the fundi it becomes broader and somewhat triangular in shape The left uterine cavity in the region of the cornu is occupied by an irregularly spherical mass approximately $1\frac{1}{2}$ cm in diameter On cut section, it is grayish-white, somewhat elevated above the surrounding endometrium In the centre of this mass is a small sac in which there is an embryo 7 mm in length The remaining mucous membrane of both the right and left uterine cavities is grayish-pink, markedly oedematous and hypertrophied, and presents the typical appearance of decidual tissue The cervical canals are $\frac{1}{2}$ cm in diameter

Histological Note—A section taken from the non-pregnant uterus shows mucosa containing very large and tortuous glands, having marked infoldings of epithelium There are also solid masses of rather pale-staining cells, characteristic of decidual cells

Six months later a second case came to us with a very different story but with what proved to be a similar anomaly, that is, a double uterus

CASE II—P B B H, Surgical No 19045 Lottie B, married, white, Canadian domestic, thirty-three years old, admitted complaining of swelling of the lower abdomen

Family History.—Essentially negative She knows of no variations from the normal in others of her family

Past History—Seven years before entry she came to the out-door department of the hospital with a generalized rash A diagnosis of lues was made and treatment with mercury and salvarsan begun The year following she had two Bartholin's abscesses on the left side which were opened The next year she married, had a miscarriage at $2\frac{1}{2}$ months, and was curetted at another hospital This patient also was never aware that there was anything abnormal about her

Present Illness—Three years before entry she discontinued her luetic treatment though her Wassermann remained positive One year before coming in, she noticed that her abdomen was getting larger without any pain or discomfort being associated with it Her periods continued normal in amount, but irregular in incidence A week before entry she first had some pain in her abdomen which exertion made worse She became nauseated frequently and her appetite disappeared The pain gradually became unbearable, so she sought relief in the hospital

Physical Examination—Except for the abdominal and pelvic examinations there was nothing abnormal found The patient was in excellent condition Her abdomen was negative except for a firm, symmetrical mass extending from symphysis to umbilicus, rather tender, fixed and flat to percussion No fluid wave could be demonstrated There was no spasm Pelvic examination showed a marital introitus and a mucoid vaginal discharge Scars of the incisions for Bartholinitis were readily seen on inner border of left labia There was no discoloration of the mucous membranes Rather high on the right wall of the vagina there was an outpocketing which was too small, however, to admit the tip of the gloved finger The cervix was posterior, and of normal color and size A mass about 15 cm in diameter, large, round, fixed and firm, slightly tender to touch could be felt filling the left vault extending well above the symphysis The adnexa were not palpable

Diagnosis—Left ovarian cyst Operation advised

June 16, 1923 *Operation Excision of Cyst of Broad Ligament (Didelphic Uterus)*—Abdominal exploration revealed a large cyst of the left broad

ligament about which was coiled the sigmoid and left tube and ovary. The cyst was removed intact, disclosing the following anomaly. Two uteri were seen, entirely separate, occupying positions on opposite sides of the pelvis, both with very short round ligaments and one tube and ovary lying in each case on the lateral side of the organ. The right uterus was very small and rudimentary, though perfectly formed in every part. The left uterus was of approximately normal size. The tube and ovary here were much attenuated and distorted by the cyst, which appeared to have arisen from the ovary. The cervix of the right uterus was very rudimentary though a thickened cord-like structure could be felt running downward

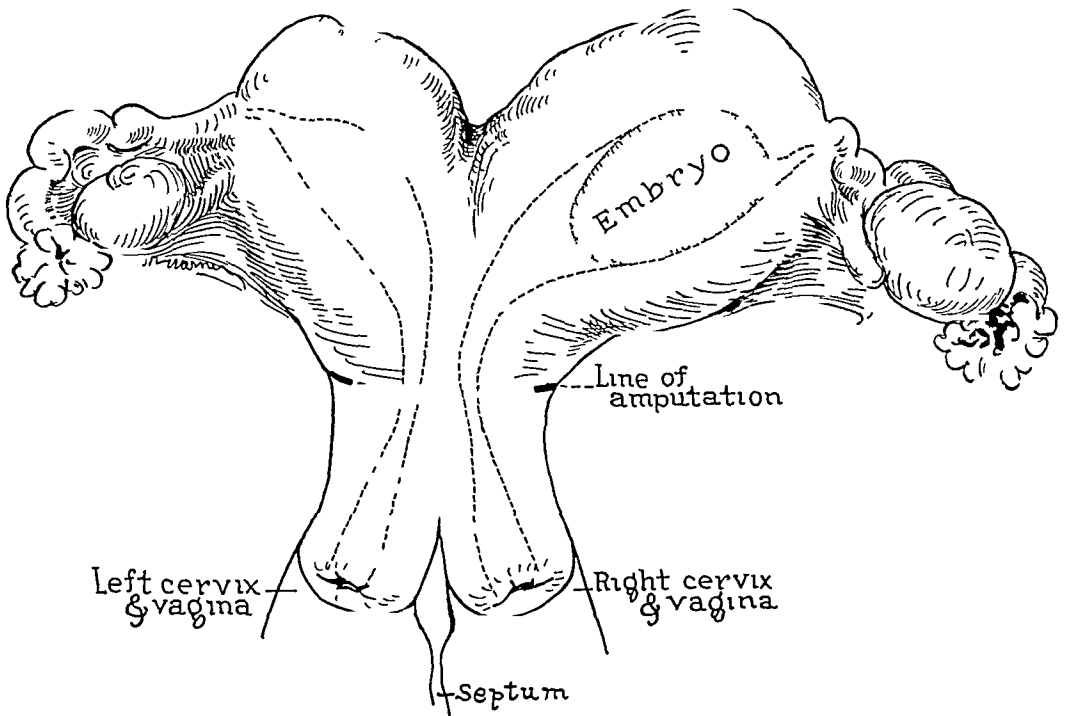


FIG 3—Case I Diagrammatic representation of condition found at operation

towards the vagina along the lateral pelvic wall. All denuded areas were carefully covered with peritoneum and the abdomen closed.

Recovery was quick, the patient being discharged July 1, 1923, fourteen days after operation. Three months later she is without symptoms.

Pathological Note—Simple ovarian cyst.

The following cases are added through the kindness of Dr H S Day, from whose private practice they are taken.

CASE III—E M W, a married, white, housewife, age thirty-nine years, complaining of low right-sided pain.

Family History—Negative.

Menstrual History—Matured at fourteen. Always regular, twenty-eight day interval, four days' moderate flow.

Past History—Married at twenty. There have been eight pregnancies. The first was a miscarriage at eight lunar months. The last three deliveries were instrumental. The oldest child is now fifteen.

Physical Examination—Showed a rather small woman, weight 115 pounds, height 5 feet. Temperature 99.2. Abdomen relaxed. Pressure above symphysis caused pain, especially on the right side. No cystocele or rectocele. Slight

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leucorrhœa Cervix very deeply lacerated and apparently adherent to the vaginal wall in such a way as to seem to be held open The fundus of uterus not found In either cul-de-sac is a large tender mass, apparently slightly movable There is more tenderness on the right side

Diagnosis—Lacerated cervix Subacute bilateral salpingitis

November 13, 1922 Operation Median laparotomy—Examination of pelvis showed a double uterus with a normal-sized body lying in each cul-de-sac Each had a tube and ovary on the outer side The left tube and ovary were normal The right tube showed chronic salpingitis The appendix was removed Examination of the cervix while the patient was still under ether showed a partition apparently separating the cervix into two mouths This partition extended from

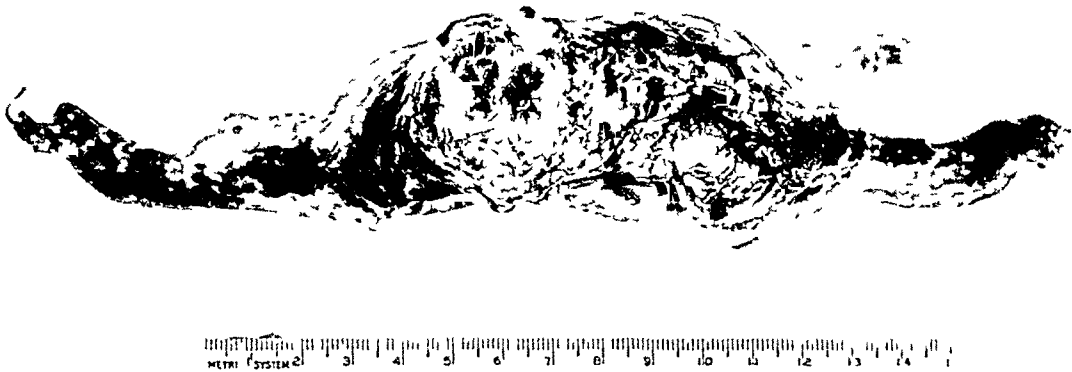


FIG 4 —Case I View from below of fresh specimen, showing integrity of the two cervical canals

above downwards, but did not seem to be completely attached to the posterior vaginal wall

Examination a month later showed patient to be entirely relieved of symptoms Pathological examination showed perisalpingitis

CASE IV—C K G, a single, white woman of twenty-nine years, first seen in June, 1918, at which time she was recovering from a slight attack of appendicitis Second attack observed in December of same year, accompanied by slight pyrexia No history of any menstrual disorder

December 11, 1918 Operation Appendectomy—Appendix found kinked and adherent Pathological report showed healed appendicitis At the time of operation, through the right rectus incision there was found a complete absence of tube, ovary and round ligament on the left side of the uterus The uterus seemed to be of normal size and was in nearly normal position The ovary on the right side appeared somewhat large The wound was closed and the patient made an uneventful convalescence

In December, 1922, she consulted another surgeon because of sterility, having been married since her first operation. An exploratory operation through a left rectus incision revealed an enlarged ovary on that side, upon which a plastic operation was done. At this time two uteri were found, of similar size, and apparently normal in size.

As previously stated, uterine anomalies are not particularly rare. We are continually meeting with one type or another clinically, at operation, or at autopsy. Keibel and Mall¹⁴ give us a very complete classification of the various inhibitions of development of the uterus and vagina, outlining the normal transition from mesonephric fold to the sexually mature uterus and grouping alongside each step in the development the various deviations from the normal.

Briefly, they find seven definite steps in the production of the normal uterus and vagina. They are (1) A completely developed mesonephric fold with as yet no trace of the Mullerian ducts, (2) appearance of the funnel of the tube in the mesonephric fold, an outgrowth of both blind ends as Mullerian ducts into the urogenital fold, (3) union of the two ducts, at first in the centre, to extend cranially and caudally, (4) rounding convexly of the flat uterine fundus, (5) strong growth of the cervix, (6) strong growth of the corpus of the uterus, (7) and finally a general growth and enlargement into the sexually mature organ.

We are able, therefore, by means of this division of development to say of any uterine anomaly at this point deviation from the normal took place. Anomalies which show absence of tubes, uterus and vagina of one or both sides are the result of faults in the completion of step (1). All double forms of uterus and vagina result as step (2) goes astray. When the Mullerian ducts fail to completely unite step (3) the bicornate forms of uterus appear. And so, too, with the last four steps, the uterus either remains flat, has an infantile cervix and vagina with normal-sized fundus, or *vice versa*, or remains small and undeveloped throughout.

Uterus didelphys is therefore the end result of a very early variation, and is also much more infrequent than are the later variations. In the first case reported here fusion of the Mullerian ducts did not take place to form a single tube in the mesonephric fold, but each duct went on to complete development side by side. In the second case, the ducts not only did not fuse but remained separate, only one developing fully. The last two cases are similar to the first.

A number of theories have been advanced to account for these disturbances. Keibel and Mall¹⁴ have collected nine from the literature. Hydro-nephrosis, distention of bladder and rectum, anomalies in the formation of the abdominal wall such as hernias, cleft pelvis, etc., and fetal peritonitis, they throw out as untenable because these factors must occur after the fusion which forms the utero-vaginal canal. Thiersch (1852), Frankl (1902) and Holzbach (1909) believe that long persistence and too great a separation of the mesonephric are the causes. R. Meyer (1898) attributes it to an abnormal shortness of the round ligament, together with too great breadth of

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the pelvis Pick (1896, 1898) believes that tumor formation between the ducts, from detached germinal tissue, is more likely the reason He found tumors present in thirty cases of double uterus Others state that a persistence of the ligamentum rectovesicale is the contributing factor Each theory has much in its favor as well as valid objections which we cannot go into here



FIG 5 —Case I Sectioned fresh specimen Note fetal sac, also decidual lining of both uterine cavities

It seems evident therefore that these variations cannot be explained on any single basis

Though the following cases by no means constitute all of this type which the literature yields, they serve, together with our own, to illustrate the clinical significance of these developmental anomalies

1 WIENER'S Case³¹ A woman of twenty-two, with complete double uterus and vagina, who had first a miscarriage for which she was curetted, decidua being found on the non-pregnant side, and then successively a normal pregnancy on right and left sides Previous to the completed pregnancies the vaginal septum was resected As the pregnancies progressed the non-gravid side was gradually taken up until at term it was hardly palpable The labors were eight and twelve hours, respectively, and uncomplicated in any way Each child showed a slight anomaly of development in hand or foot

2 HYDE'S Case³² A young woman in whom a didelphic uterus was discovered, and on whom an operation was performed for removal of the vaginal septum in preparation for marriage Six months after marriage she became pregnant She went to full term without trouble and delivered a normal healthy child

3 SHOEMAKER'S Case³⁷ A twenty-four year old white woman with double uterus and rather fibrous vaginal septum, who miscarried at 2½ months, to become

pregnant later on the right side. She came to term, started a normal labor, but was delivered by Cæsarean section of a normal, healthy baby.

4 ARANOW'S Case² An Austrian of twenty-four years with complete double uterus and vagina, who miscarried six months after marriage and was cured. Postpartum infection followed. She came to Aranow because of sterility.

5 COWLES' Case⁴ A twenty-three year old woman with uterus didelphys, who became pregnant four years after marriage, went into labor at term, but after making little progress forty-eight hours after rupture of the membranes was delivered by Cæsarean section and a subtotal hysterectomy done. The child had a slight deformity of the left hand. Two years later she became pregnant again,

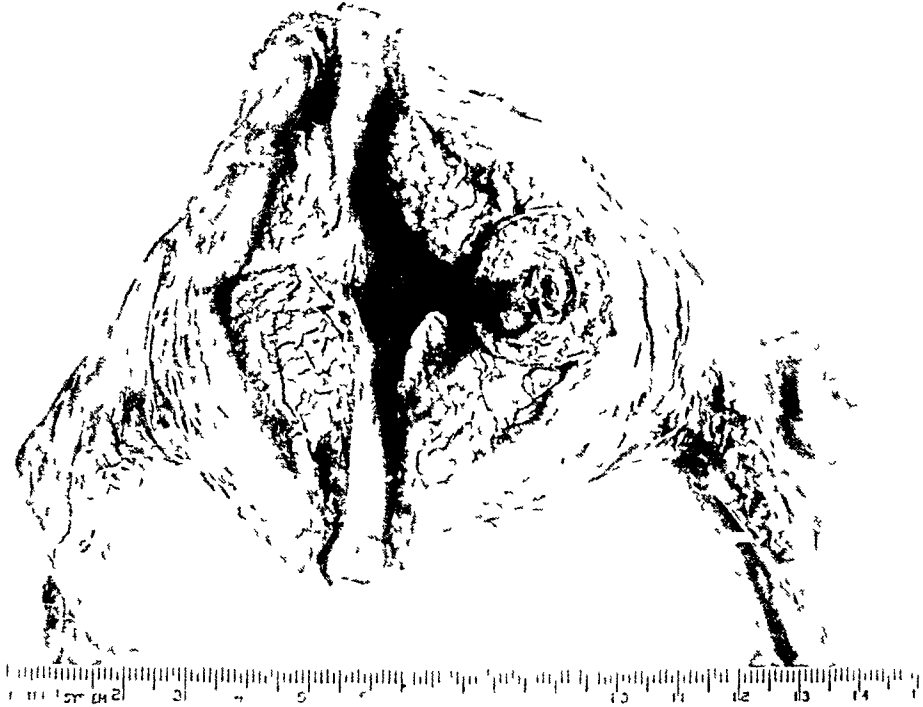


FIG 6—Case I. Fixed specimen. Note embryo within fetal sac.

on the remaining side, and was delivered at term by Cæsarean section of a baby who was healthy and normal except for a slight deformity of one foot.

6 VINEBERG'S Cases³⁰ (a) A woman with double uterus and vagina, who had had numerous pregnancies, some resulting in miscarriages. Both cervixes were lacerated, indicating function of both sides. (b) A woman twice pregnant on the same side. During the first pregnancy, by pressing on the opposite side, decidual tissue could be expelled. This manœuvre caused a drop in the slight fever the patient was showing. Both pregnancies terminated in normal deliveries. (c) A patient of thirty-one, who was successively pregnant on the right and left sides, miscarrying both times.

7 RONGY'S Case⁴ A woman with double uterus, who miscarried at four months and five months, later gave birth to a full-term child.[†]

8 JOHNSTONE'S Case¹⁰ A woman who died of eclampsia after forceps delivery without difficulty. At autopsy a double uterus and double vagina were found, the non-pregnant side containing a thick layer of decidual cells.

[†] Though the author does not explicitly say so, there must have been pregnancy on each side at the same time in this instance.

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Clinical Significance These few cases, briefly abstracted, with the cases reported here, emphasize the following facts. Uterus didelphys may well be more common than is believed inasmuch as many cases are not recognized at once, and others not even after repeated examinations. Though opinion varies considerably as to the advisability of allowing such patients to go through a normal labor, still many do so without untoward results. Miscar-

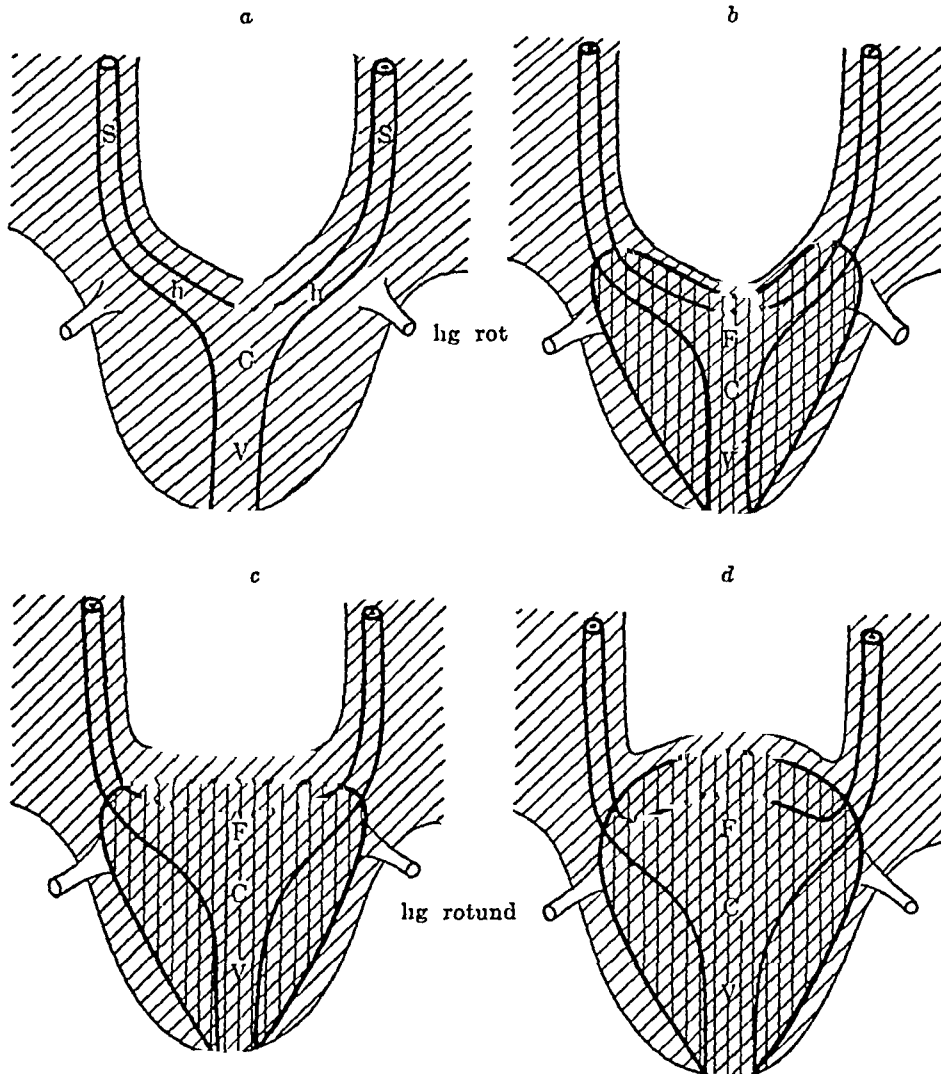


FIG 7—(Reproduced from Keibel and Mall) Four diagrams of the development of the external form of the female uterus. The mesonephric folds and the genital cord are shaded obliquely; the mesenchymatous uterine wall vertically. The various parts of the primitive uterine wall and of the utero-vaginal canal are lettered: S, vertical portion; h, horizontal portion of the wall of the primitive tube; F, fundus uteri; C, cervix uteri; V, vagina. Diagram (a) shows the position of the primitive tubes and of the utero-vaginal canal after it is completed. Diagram (b) shows the relation of the mesenchymatous uterine wall to the primitive tubes and to the utero-vaginal canal. It encloses the whole of the horizontal portion of both tubes in the uterine region and as a result the lig rotundum is brought into relation with the uterine wall. The fundus uteri is bent in at an angle (*uterus introitus arcuatus*). Diagram (c) shows the broadening of the horizontal portion of both tubes to form the fundus uteri, the broadening taking place in such a way as to straighten out the inward bend (*uterus planifundus*). Diagram (d) The broadening of the fundus has increased and it is curved outward (*uterus foras arcuatus*).

riages are not uncommon in these cases and this factor is usually the first symptom of anything abnormal which causes the patient to seek medical advice. The possibility of double pregnancy is always present, though rare. Resection of the vaginal septum would conceivably make this more likely, though we have little data to support this belief. One thing seems indisputable. This anomaly proves no bar to the normal fulfilment of the marital

function, and when combined with careful observation and prenatal care, normal labor or Cæsarean section make it possible for patients with this deformity to have children. An interesting observation in such cases is the appearance in the non-gravid side of decidual membrane.

To Summarize Four cases of uterus didelphys are reported. This condition, one of the rarer uterine anomalies, is the result of a failure of fusion between the two Mullerian ducts. It is usually unrecognized until pregnancy occurs and is no bar to the successful termination of the latter.

BIBLIOGRAPHY

- ¹ Anvray. Uterus bicornis avec double salpingite. Bull. and Mem. Soc. de chir. de Par., 1919, vol. xlv, p. 1136.
- ² Aranow, H. Uterus Didelphys and Double Vagina. Am. J. Obst., N. Y., 1919, vol. lxxix, p. 823.
- ³ Bab, H. Uterus duplex und Hypertrichosis. Ztschr. f. Geburtsh. u. Gynak., Stuttg., 1917-18, vol. lxxix, pp. 364-378.
- ⁴ Bartholomew, R. A. Report of a Case of Uterus Didelphys with Hematocolpos in an Atresic Lateral Vagina. South M. J., Birmingham, 1919, vol. xii, pp. 691-694.
- ⁵ Baudet, C. Uterus didelphe avec une cavite gravidique, l'autre conduisant dans un vagin imperforé, ayant donné lieu à un hematocolpos. Bull. et Mem. Soc. anat. de Par., 1920, vol. xc, pp. 466-469.
- ⁶ Cornell, E. L., and Earl, W. C. Uterus Bicornis Unicollis with Two Ova Implanted in One Horn and a Fibroid in the Other. Surg., Gynec. and Obst., Chicago, 1919, vol. xlix, pp. 485-489.
- Cowles, H. C. Case of Pregnancy Following Cæsarean Section with Subtotal Hysterectomy in a Case of Unrecognized Uterus Duplex. Am. J. Obst. and Gynec., St. Louis, 1922, vol. iii, pp. 652-655.
- ⁸ Dobie, D. R. Pregnancy and Labor in a Double Uterus with Notes of an Illustrative Case. Tr. Edinb. Obst. Soc. (1920-21), 1922, vol. xli, pp. 20-26.
- ⁹ Felix, W. In Human Embryology, Keibel and Mall. J. P. Lippincott Co., Philadelphia, vol. ii, p. 930.
- ¹⁰ Grammeltopt, S. A. Deux cas d'uterus rudimentaire double traités par opération. Arch. mens. d'obst. et de gynéc., Par., 1918, vol. vii, pp. 285-293.
- ¹¹ Hirst, B. C. The Operative Treatment of Uterus Subseptus or Semipartus with a Case Report. Am. J. Obst., N. Y., 1919, vol. lxxix, p. 790.
- ¹² Hyde, L. W. A Case of Double Vagina and Double Cervix. J. Am. Med. Assn., Chicago, 1920, vol. lxxv, p. 877.
- ¹³ Johnstone, R. W. Uterus Didelphys. Tr. Obstet. Soc. Edinb., 1921-22, vol. lxxxi, p. 85.
- ¹⁴ Keibel and Mall. Manual of Human Embryology. J. B. Lippincott Co., Philadelphia and London, 1912, vol. ii, p. 930.
- ¹⁵ Kerr, J. M. M. The Surgery of the Uterus Bicornis Unicollis, with a Case of Resection of Uterus Followed by Two Normal Pregnancies. Proc. Roy. Soc. Med., Lond., 1920-21, vol. xiv, Sect. Obst. and Gynec., pp. 190-193.
- ¹⁶ Kerr, J. M. M. Notes on a Case of Uterus Bicornis Unicollis (Symmetricus) in which Resection of the Uterus was Performed, and Followed by Two Normal Pregnancies. Glasgow M. J., 1921, vol. xcvi, p. 173.
- ¹⁷ Luque. Utero doble. Med. ibera, Madrid, 1920, vol. xiii, p. 173.
- ¹⁸ Marcondes, V. Observacao de um caso de utero didelphos. Ann. Paulist. de med. e cirurg., S. Paulo, 1920, vol. xi, p. 110.
- ¹⁹ Moloff. Un cas d'uterus bicornis avec col double dans sa partie supérieure et simple dans sa portion vaginale. Schmerz med. Wchnschr., Basel, 1921, vol. li, p. 1077.

UTERUS DIDELPHYS

- ²⁰ Nemes A Uterus duplex separatus cum hæmatometra Wien klin Wchnschr , 1921, vol xxxiv, p 440
- ²¹ OKinczyc, J, and Huet, P A Un cas d'uterus didelphe, salpingite unilaterale et hysterectomie unilaterale Gynec et Obst , Par , 1921, vol iii, pp 15-20
- ²² Prentiss, C, and Arey, L Text-book of Embryology W B Saunders Co , Philadelphia Second edition, 1918, p 220
- ²³ Robertson, B C Congenital Absence of Uterus, Both Tubes and Right Ovary South M J , Birmingham, 1920, vol xiii, p 205
- ²⁴ Rongy, A Discussion Am J Obst and Gynec , St Louis, 1922, vol iii, p 654
- ²⁵ Rospi, S Uno caso di vagina doppia e di utero doppio Gazz med napolet , 1919, vol ii, pp 367-372
- ²⁶ Royster, H A Malformations of the Uterus, with Clinical Reports Am J Surg , N Y , 1922, vol xxxvi, pp 110-113
- ²⁷ Shoemaker, J Double Uterus, Cæsarean Section for Delivery of Pregnant Right Uterus at Term J Am Med Assn , Chicago, Jan 13, 1923, vol lxxx, p 103
- ²⁸ Steele, H A Case of Vaginal Septum and Bicornate Uterus J Am Med Assn , Chicago, July 31, 1923, vol lxxv, p 309
- ²⁹ Thorek, M Double Uterus Chicago M Recorder, 1919, vol vi, pp 430-435
- ³⁰ Vineberg, H Discussion Am J Obst and Gynec , St Louis, 1922, vol iii, p 654
- ³¹ Weiner S Report of the Unusual Life History of a Uterus Didelphys Am J Obst and Gynec , St Louis, 1921-22, vol ii, pp 552-554

ENCYSTED FOREIGN BODIES*

By FRANK PASCHAL, M D

OF SAN ANTONIO, TEXAS

FOREIGN bodies may be introduced from without or originate within the body "The presence of a foreign body excites the assemblage of phagocytes and leucocytes, which aid in the granulation tissue developing about it Large multinuclear giant cells form and cling to the foreign body These cells resemble the physiological osteoclasts, and, in unabsorbable substances, gradually

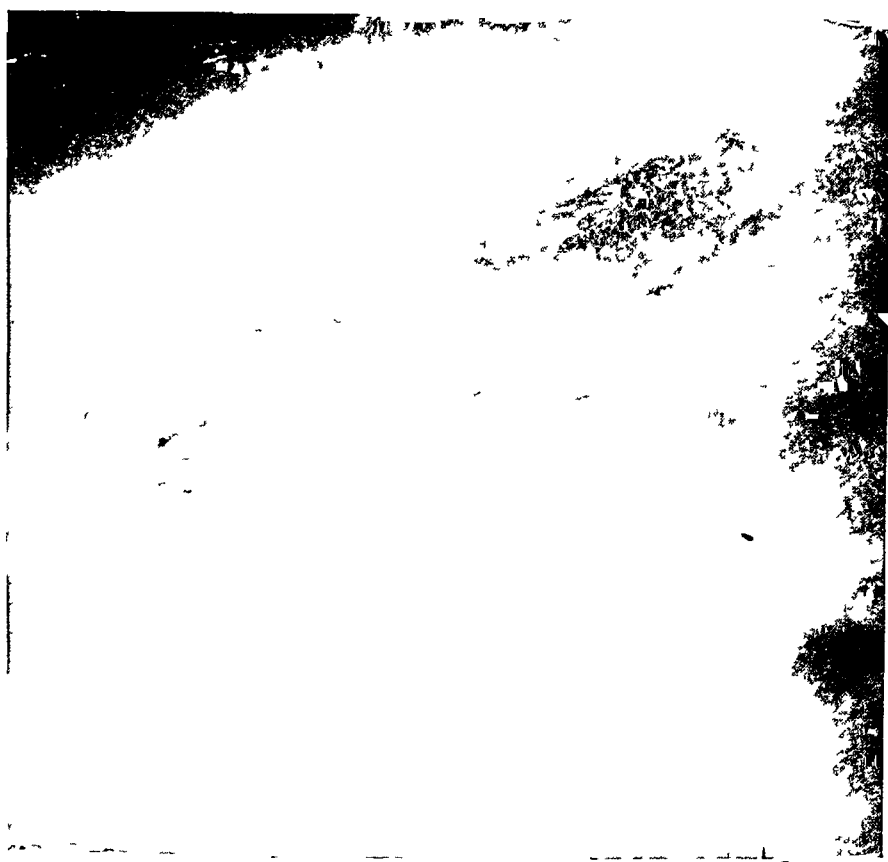


FIG 1 —Arrow point encysted for sixty one years without causing inconvenience or pain
It is between the second and third ribs never removed

give place to a capsule of scar tissue which encapsulates the body In cases of smooth bodies, like glass, the amount of granulation tissue may be very small The leucocytes also play an important role in the reaction against foreign bodies They usually quickly assemble at their site, take them up when possible, penetrate into crevices, and aid in the process of destruction Fibroblastic proliferation follows or is associated with the assemblage of

* Read before the Texas Surgical Society, October 9, 1922

ENCYSTED FOREIGN BODIES

leucocytes Many of the fibroblasts act as phagocytes and also aid in encapsulation" The toleration of foreign bodies depends largely upon the absence of infection Sometimes, even under the most unfavorable conditions, foreign bodies that have been introduced from without become encysted, remain so, and are carried a lifetime without pain, inconvenience or knowledge of where they are lodged As an instance, the X-ray photograph (Fig 1) presented shows an encysted arrow-head The subject at the age of sixteen was engaged in an Indian fight, May 12, 1858, with Commanche Indians, in what is now Ellis County, Oklahoma The arrow penetrated below the seventh rib He died at the age of seventy-seven During the sixty-one

years, he was not annoyed by its presence and carried it with him to his grave He told me that when the shaft pulled away from the arrow-head, that one of his companions attempted to cut down on the point with a jack-knife This he said came near finishing him, but notwithstanding a dirty arrow-head and a jack-knife wound, he escaped infection, and the point encysted for years was of no consequence to his well-being But we know that the wind is not always tempered to the "shorn lamb" In contrast to the above case is the following A

Mexican, male, age thirty-eight, in seeking relief

stated that when eighteen years old, he was wounded by Indians That an arrow-point that could not be removed had remained in his back for twenty years That during the first eight years it did not trouble him, but after that time, an abscess formed at the seat of entrance and that he had suffered for twelve years Upon examination there were discharging sinuses and healed abscess surfaces from the middle of the dorsal region of the spine almost to both feet The point was easily located about the middle of the dorsal region, about two inches from the spinous processes in the lumbar muscle There was no difficulty in its removal The point had become very rough and oxidized He carried the arrow-point for twenty years, eight of which were without discomfort and twelve of misery

Coincidences in cases are sometimes queer A Mexican, male, age twenty-eight, occupation blacksmith, came into my office one night complaining of



FIG 2 —Piece of glass encysted for eight years and which gave no trouble until accidentally revealed by a blow

severe pain in the anterior aspect of the middle right thigh. He stated that about four o'clock that same afternoon that in breaking a piece of iron part of it flew off and struck him on the thigh, immediately he began suffering severe pain at the seat of injury, that he did not know whether a piece of iron had penetrated the thigh, that eight years before, he had fallen on a piece of glass bottle, that he noticed at the time a small wound, but paid no attention to it, and that he had never suffered until he was struck by the

piece of iron. Upon examination I found a small fresh wound in the middle of the thigh, further examination revealed a piece of glass (Fig 2) which was found about one-half inch in the external vastus muscle. This body was only revealed by the accidental blow, otherwise it might have remained there during his lifetime. It was easily removed, and prompt relief followed. But notwithstanding that foreign bodies may become encysted and not give rise to trouble, we all can, no doubt, recall cases where foreign bodies have been quiescent for twenty, thirty, or more years and then all of a sudden inflammation developed at their site, an abscess formed, and if the body could not be removed, trouble would result and possibly death.

As an example of foreign bodies originating inside the body, the four small bony plates shown in Fig 3 were found in the interior of atrophied



FIG 3 —Bony plates (4) found in four atrophied eyeballs. In centre a foreign body from abdomen

eyeballs which were enucleated as a means of preventing blindness, from atrophy of the optic nerve of the remaining eye. You will notice in two of the pieces a small foramen, possibly the opening for a nutrient blood-vessel. Of course such plates are not infrequently found in eyes that have atrophied, nevertheless, they are interesting in showing how long they can be carried and give rise to little or no trouble. The sympathetic atrophy of the optic nerves of the sound eyes was not due to the bony plates, and they probably played no part in their production. Each of the bony plates exhibited are from four atrophied globes. They are probably bony degeneration of the retinae. They occupied their site. You will notice a small round body in the centre

of the bony plates, it is shown as an interesting connection with a case Recovering the piece was merely accidental About 1886, before we knew anything about appendicitis, but considered such cases as typhlitis and perityphlitis, an American woman about forty-five, was seized suddenly with pain in the right side over the cæcal region This was followed by high fever, and finally a circumscribed peritonitis Through the cul de sac a collection of pus could be felt, and it was reached by an incision behind the uterus and drainage established Several days after the operation, an examination revealed the small body emerging by the side of the drainage tube If it played any part in causing, what I did not know then, but do now, a perforated appendix, I do not know, but think its presence probably in the appendix was coincidental

A practical question to be deduced from this paper is whether foreign bodies, for instance, bullets, that can be located, and can be removed with safety, should be allowed to remain and chances taken of no harm resulting, or should they be removed early? The tendency seems to be to let them alone Personally I believe that if such cases are seen soon after the foreign body has entered, that it would be better not to let the patient take chances, because we can never tell how strongly encapsulated it may become, if encapsulated at all, or how potent the defenders of the fort may be, or how virulent and powerful the invading pus germs that may enter and storm the fort After years of toleration of a foreign body, and there are no indications for its removal, then, of course, it would be better to wait

SACRAL ANÆSTHESIA*

By EDWARD C. BRENNER, M.D.

OF NEW YORK, N. Y.

SACRAL or caudal anæsthesia has been safely and rather successfully employed in many of the Continental Clinics for over a decade. Its dilatory application in American surgery has been due to several unfortunate impressions: (1) That this type of regional anæsthesia is closely related to spinal anæsthesia, (2) that it is hazardous, (3) that special skill and technic are necessary for its success, and (4) that the resulting anæsthesia is uncertain both as to degree and to anatomical distribution.

Sacral anæsthesia is extradural nerve blocking of the sacral sensory nerves. It is purely a conductive anæsthesia by which a more or less extensive

complex of sensory nerves are interrupted. The anæsthetic acts upon the nerves only after they have left the dural sheath and therefore should not be confounded with spinal anæsthesia. Moreover, with proper technic it is



FIG. 1.—Variability in the size and curvature of six sacra

impossible for the injection fluid to enter the dural canal.

Cathelin in 1900 injected 3 c.c. of 1 per cent cocaine solution into the caudal foramen of dogs and produced extensive anæsthesia. Later his attempts to anæsthetize the sacral nerves in humans suffering from pelvic neurosis proved futile. With the advent of the relatively non-toxic agents, stovaine and novocaine, a new impetus was given to nerve blocking. Stoeckel, in 1909, modified Cathelin's technic and successfully employed sacral anæsthesia in ameliorating the pains of labor and in producing anæsthesia for plastic perineal operations. Stoeckel was followed by Schlemper, Schneider and Koenig. Each added his quota in exploring and developing this new field. Enthusiasm led them to use increasing amounts and with the addition of narcotics they were able to perform abdominal operations. This they termed high extradural anæsthesia. Some cadaver experiments to be referred to later will indicate the possibilities of high anæsthesia.

Lawen and Gros in 1910 reported excellent results from the use of one and two per cent solutions of novocaine in normal saline solution and later increased the intensity of the anæsthetic by the addition of sodium bicarbonate. Some American surgeons were impressed by the steady progress of the sacral

* Read before the Surgical Section of the New York Academy of Medicine, May 4, 1923.

technic and since 1916, Lewis and Bartels, Pickens, Thompson, Lynch, Syms, Scholl and others have added their records of experiences. However, the paucity of published data should encourage other observers to report their successes and failures, especially the latter, if sacral anæsthesia is to be perfected to the proper degree of more general application which it merits.

The writer first employed sacral anæsthesia in 1918 and meeting with only quasi success attempted some experiments upon cadavers to investigate (1) the anatomy of the sacral canal (the description of which in most anatomies is rather incomplete or absent), (2) the course taken by injections of various quantities of solution, realizing that such findings are only relatively accurate when applied to injections in *vitam*.

The first anatomical point worthy of mention is the great variability in the curvature of the lower sacral bone segments. In males the curvature is more pronounced than in females. Secondly, the sacral ligament (sacroccygeal ligament), overlying the sacral hiatus, is variable in size and shape. In general it is rather triangular, less often quadrilateral. Except in the obese, the hiatus is readily palpated at the lower end of the sacrum by sliding the finger upwards from the tip of the coccyx until an elastic-like membrane is felt between the cornua of the sacrum and coccyx and the last spinous process of the sacrum (fourth segment). Occasionally the sacral ligament is partially ossified and the hiatus is sufficiently small to prevent entrance of the needle. Rarely a hypertrophic intervertebral disc is found between the third and fourth sacral segments which by protrusion into the sacral canal may obstruct the passage of the needle. The caudal end of the dural sac usually ends between the first and second sacral segments, occasionally extending as low as the level of the junction of the second and third segments. This point averages 6 to 9 cm. from the sacral ligament. In one case it was only 4 cm. Allowing for the thickness of the soft parts overlying the sacral ligament, a needle may safely be inserted 5 cm. without fear of entering the dural sac.

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When 20 c.c. of methylene blue solution is injected into the cadaver the sacral canal is filled but without tension. The second, third, fourth and fifth sacral nerves are bathed in the solution as they pass through the canal. Thirty

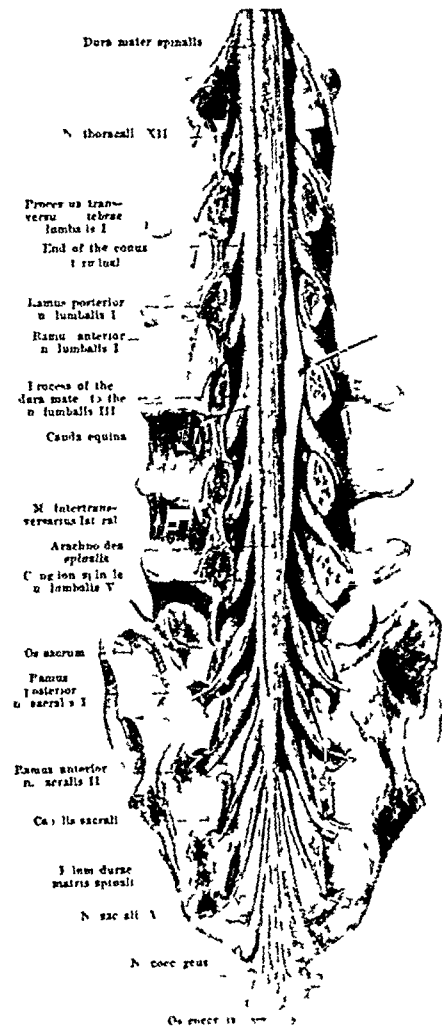


FIG. 2.—Spinal cord and membranes

cc of fluid in the average case fills the caudal canal under slight tension and the injection fluid passes out about 3 cm along the nerve roots of all the sacral nerves and occasionally the last lumbar, 45 cc of fluid reached the level of all the lumbar nerves and permeated out onto the nerve sheaths 3 to 5 cm. When 60 cc were employed the lower 3 to 6 dorsal nerve root sheaths became injected, 90 cc caused permeation of all the dorsal nerve sheaths. In all the experiments the dura about the cord was stained from

three to five inches above the level of the permeation of the nerve sheaths. In four cadavers in which 120 cc were injected, the solution permeated the nerve sheaths as high as the second or third cervical. It should be emphasized that in none of these experiments did any of the fluid enter the dural space despite the force required to inject such quantity. Therefore, it would seem that the danger of producing spinal or intradural anaesthesia is quite remote if proper technic is adhered to, and also that a rather high level of anaesthesia should obtain when 60 cc or more are injected.

Technic of Injection—Certain details must be carefully adhered to and failure to comply with these

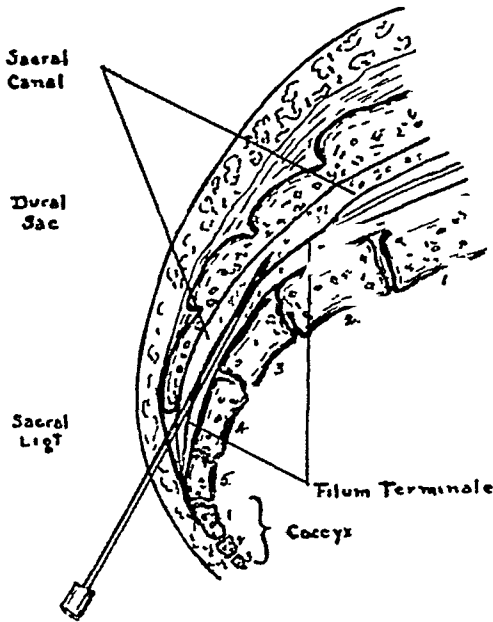


FIG 3 —Direction and course of needle

courts disaster. Unless contraindicated, a preliminary injection of hyocin gr 1/150, morphine gr 1/6 and atropine gr 1/150 is administered 45 minutes beforehand. The mild twilight usually obtained is a distinct adjuvant, especially in neurotic types. For the sacral injection, the patient lies prone with a pillow under the hips. The skin area is iodized and the sacral hiatus palpated. A few minims of 2 per cent novocaine solution anaesthetizes the overlying skin and sacral ligament. The spinal puncture needle (3 inches in length, gage 20) with stylet *in situ*, is first passed through the skin and ligament at right angles about 5 cm below the apex of the hiatus. As the needle passes through the ligament, a peculiar snap is felt, much the same as in performing lumbar puncture. The shoulder of the needle is then depressed until the needle is parallel to the long axis of the canal. No further obstruction is encountered if the needle is properly directed in the canal, and with very slight force it is readily insinuated for one and one-half inches.

Any obstruction during the passage of the needle connotes an improper plane of insertion and by slowly elevating or depressing the shoulder, a proper entrance should obtain. The stylet is then withdrawn and if no blood or spinal fluid escapes (the latter has not occurred in this series) 30 cc of freshly

re toxic than when injected intramuscularly. Some authors addition of other salts to the novocaine solution, viz, sodium sodium, or sodium sulphate, *et cetera*, claiming that such mixture lasting anaesthesia. In this series at first the following employed

sodium bicarbonate	0.15 gm
sodium chloride	0.10 gm
novocaine	0.60 gm
water	30.00 c.c.

For 80 cases freshly prepared sterile 2 per cent novocaine in normal saline was employed to each 30 c.c., of which was added epinephrine. This solution, so simple of preparation, is quite as effective as the one with sodium bicarbonate. It is important to inject the fluid and no resistance is offered except to the last few c.c. of fluid. The patient feels this slight resistance to the last few c.c. indicates that the fluid is quite completely filled and in many cases where no resistance is offered, a few additional c.c. of either novocaine solution or simply sterile water are injected until some resistance was felt. More complete anaesthesia is obtained with this addition to the usual technic. The patient experiences a sense of fullness or weight in the sacral region during the injection. Usually nothing is complained of. If the patient experiences discomfort, it is faulty. At the completion of the injection, the needle is withdrawn and a drop of collodion is placed over the puncture site. The patient is kept up, that gravity may aid in holding the fluid in contact with the tissues.

After the onset, the area of distribution and the intensity of the anaesthesia show considerable variation. Anaesthesia usually begins about the first or second five minutes. When complete anaesthesia obtains there is no sensation in the perineum and with an area of anaesthesia covering the sacrum, the inner thighs as represented in Fig. 4. The anterior urethra is anaesthetized in about 10 to 12 minutes, the meatus, internal sphincter, and prostate requiring about 20 minutes. In the female the perineum, vagina, cervix and urethra are anaesthetized in about 15 minutes. The labia minora usually retain sensation. Occasionally only partial anaesthesia occurs. In such cases a second injection of 10 to 20 c.c. is usually sufficient to insure complete anaesthesia.

The duration of complete anaesthesia generally exceeds two hours. Often 24 to 48 hours for full restoration of sensation and this partial anaesthesia may insure a painless convalescence. Some of the rectal operations had not been operated upon

The dangers of sacral anæsthesia seem practically nil if proper technic is employed. Three patients in this series complained of intense headache immediately after the injection. All were promptly relieved by sitting up. Only one patient, a drug addict, had vertigo. Several patients complained of slight palpitation and a few presented some pallor. These symptoms were mild, transient and never alarming. A few cases have been reported where

the needle has been broken off in the canal. With good needles and stylet *in situ* this should not happen. A colleague had an extensive infection of the back muscles from possible puncture of the rectum. No fatalities, palsies or late untoward results have been reported where proper technic has been adhered to.

All observers report some percentage of failures. In this series of 120

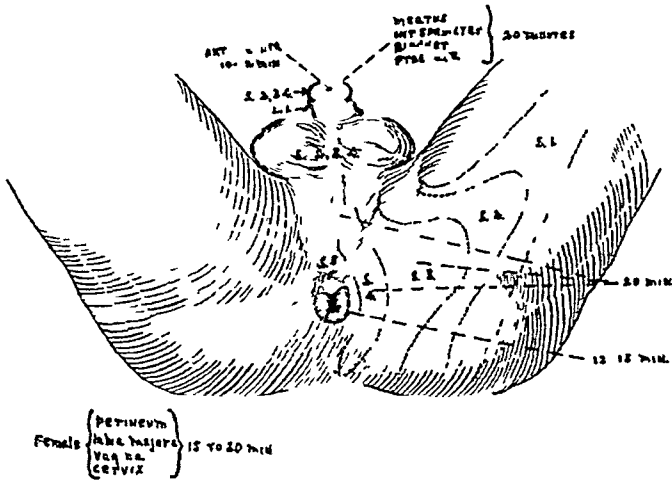


FIG 4—Time and distribution of anæsthesia

cases there were 12. In 5 of these cases poor anæsthesia resulted and in 7 no anæsthesia (10 per cent failures), in 10 cases (8 per cent), a second injection was required to produce satisfactory anæsthesia. No complications occurred.

In 3 of the 12 failures by the caudal bloc a successful anæsthesia was obtained by transsacral injection. The following operations were performed:

TABLE I
Case Records

Surgical condition	No of cases	Average amount of injection	Time elapsed before anæsthesia was complete	Satisfactory anæsthesia	Failures
Hemorrhoids	65	31 c c	22 min	61	4
Rectal polyp	1	25 c c	20 min	1	0
Condylomata	2	30 c c	20 min	2	0
Ischio-rectal abscess	6	32 c c	21 min	5	1
Stricture of rectum	1	30 c c	20 min	1	0
Anorectal fistula	20	31 c c	22 min	17	3
Perineorrhaphy and trachelorrhaphy	4	33 c c	22 min	3	1
Cystoscopy	4	30 c c	20 min	4	0
Circumcision	3	30 c c	20 min	2	1
Prostatectomy (perineal)	2	40 c c	25 min	1	1
Prostatectomy (supra-pubic)	4	30 c c	20 min	4	0
External Urethrotomies	8	31 c c	22 min	7	1
Total	120	31 c c	21 min	108	12

(1) Supra-pubic infiltration with 2 per cent novocaine

(2) Three caudal bloc failures were successfully anæsthetized by trans-sacral conduction

CONCLUSIONS

(1) Sacral anæsthesia if properly administered is a safe procedure and should not be confounded with spinal anæsthesia

(2) The motor nerves are not affected and the three lower sacral sensory nerves are those chiefly anæsthetized by conduction

(3) With proper technic successful anæsthesia will result in the majority of cases Failures grow less as one becomes more experienced

(4) It would seem that sacral anæsthesia is deserving of more general application in rectal, genito-urinary and perineal surgery

(5) One should be familiar with the technic of transsacral conduction in case of failure of the caudal bloc

Indebtedness is due Dr John M O'Connor for his kind assistance in the cadaver experiments, and for administering several of the sacral injections

INSTRUMENTARIUM FOR LOCAL ANÆSTHESIA

By WILLIAM R. MEEKER, M D

OF ROCHESTER, MINN

FROM THE SECTION IN ANÆSTHESIA OF THE MAYO CLINIC

As in all other surgical procedures, satisfactory work in local anæsthesia cannot be performed with unsuitable instruments. It is not at all necessary to

have a complicated outfit for the application of the various methods of local anæsthesia. All that is essential is the proper supply of needles and syringes.

In the selection of a syringe, the best make will usually be found the cheapest in the end. A syringe that leaks, or in which the plunger fits too tightly, should be discarded. The plungers of many syringes jam so tightly into the barrels that a certain amount of rotation is necessary in order to make the plunger advance. Such a manœuvre necessitates grasping the syringe with both hands, a procedure which interferes with the accurate control of the needle point. If the piston does not work smoothly within the barrel, the solution will be expelled unequally and cause pain by the sudden dilatation of tissues. The most common fault of syringes is that the barrel differs in calibre in different portions. In the narrow portions, the piston advances

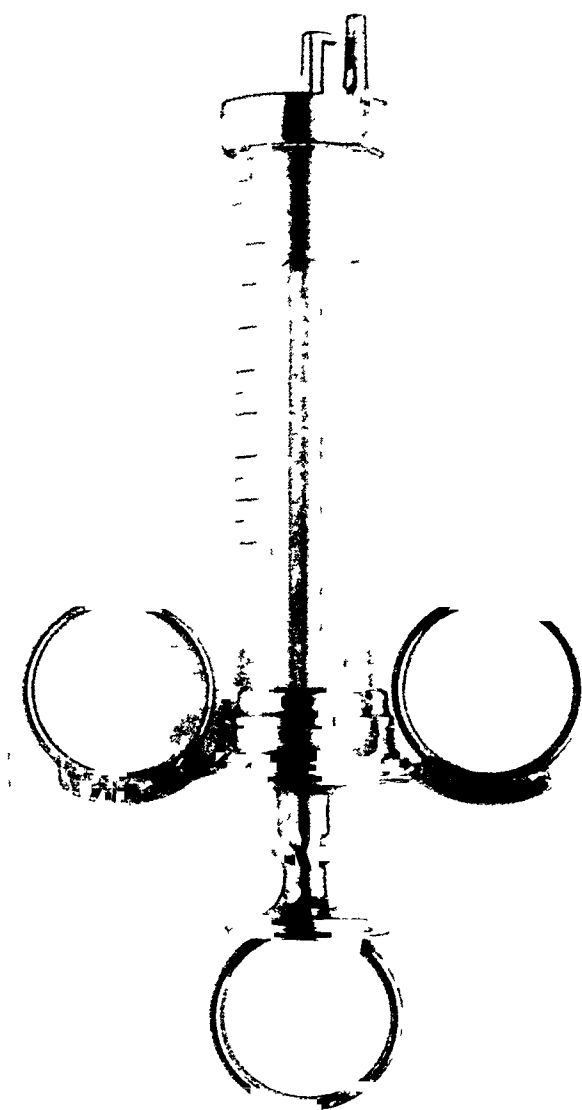


FIG. 1.—Labat's syringe modified by the addition of three rings for the hand grasp.

with difficulty, while in the wider parts it permits the fluid to leak back.

The syringe should be simple in structure so that it will not get out of order and may be easily sterilized, either by boiling or by immersion in antiseptic solutions. All washers and packing are to be avoided, as they soon wear out and are unsanitary. An eccentric tip for the connection with the

needle facilitates injection parallel with the surface of the skin and makes the manipulation easier in regions where the bony prominences of the body are in the way. Such an arrangement obviates the necessity of having the needle fixed at right angles to the barrel, as in the Hackenbruch syringe. A right-angled attachment interferes with delicacy of manipulation, and it is difficult to feel the location of the point of the needle the location of which constitutes really the whole secret of local anæsthesia.

The needle should fit the tip of the syringe securely and fasten by means of a bayonet-lock attachment. The screw tip for attaching the needle is of no practical value since the needle very often must be introduced free from the syringe. Even when introduced attached to the syringe as in terminal infiltration, it must be detached frequently for refilling of the syringe.

The proximal end of the syringe should be provided with an arrangement for making counter-pressure. Of these, rings are by far the best. A ring on the end of the plunger for the thumb and one on opposite sides of the barrel cover for the index and second fingers will enable the operator to aspirate or refill the syringe with one hand, and also give him better control of the syringe in progressive injection both during advancement and withdrawal of the needle.

The all-glass syringes have the disadvantage that they break too easily, especially the tip on which the needle fits. Such syringes fit the hand poorly, require the use of both hands for refilling or aspiration, and possess no locking device for attachment of the needle. The all-metal syringes, while very durable, possess the drawback that the operator cannot see the solution. It is thus impossible to eliminate the possibility of injecting the anæsthetic solution into the blood-vessels by aspiration. This feature is not of great importance in terminal infiltration because the needle is kept constantly moving while the injection progresses. In nerve block and sacral anæsthesia, however, aspiration is of greater value.

The most desirable syringe is one with a metal piston and glass barrel with metal mountings. The Record syringe does not fulfill the requirements



FIG. 2.—A 15 cm. needle showing the use of the anchor from a tie pin to mark depth as in splanchnic nerve block.

mentioned. It is too short and thick, difficult to grasp, and contains no arrangement for making back pressure. In our experience the Labat syringe, made by Gentile and Company, of Paris, most nearly fulfills all requirements of a syringe for local anæsthesia. Of 10 c.c. capacity, it is large enough to

obviate the necessity of frequent filling and at the same time not large enough to be cumbersome. It is short enough when filled so that the thumb can be conveniently brought behind the plunger to force out the solution without grasping the syringe with both hands. The drawback of higher cost is easily overcome by the excellent workmanship, durability and smooth running qualities. It is provided with an eccentric tip and locking device for needles. With the aid of Mr. George Little, instrument-maker of the Clinic, this syringe has been modified by the addition of three rings for the hand grasp (Fig. 1). This makes possible aspiration and refilling of the syringe with one hand and enables the operator to manipulate it more deftly, especially in fanwise injections, and in the more inaccessible locations of the body.

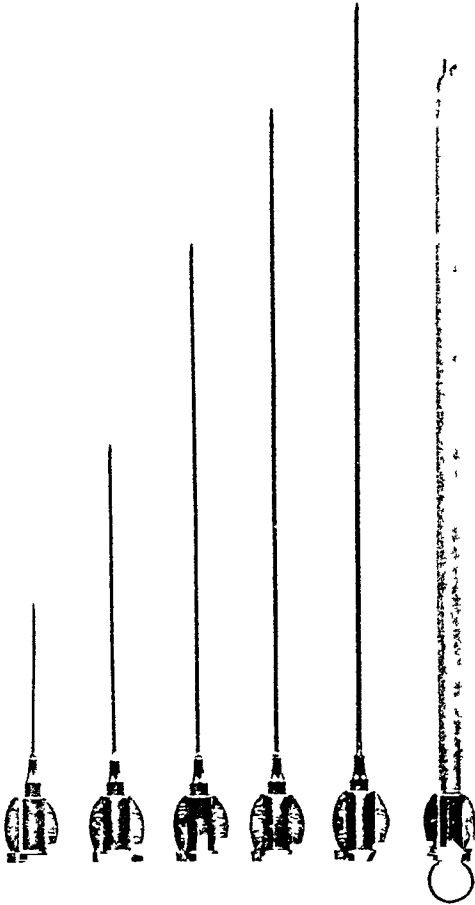


FIG. 3.—Labat's regional anæsthetic needles provided with special bayonet-lock hub.

Of no less importance than the syringes are the needles. These must be as fine as their stability will permit, thus minimizing the pain caused

by their passage through the tissues. With a small needle an injury, such as the unintentional pricking of a blood-vessel, will not be of serious consequence. Needles should be slightly flexible but not easily bent. There should be an assortment of different lengths for the different anæsthetic procedures. The beginner is likely to underestimate the depth of nerve trunks and tissue planes and use a needle too short to reach the sensitive area.

The material of which the needles are made should be, first of all, such that they will maintain a sharp cutting edge. For this reason, steel needles have been found to be the best. Needles need not necessarily withstand sterilization in a flame, as sterilization is more easily and thoroughly accomplished by boiling. Platinum and platino-iridium needles are too costly, bend too readily, and become blunt too easily. Tempered gold needles possess the same disadvantages. They should be provided with a bayonet-lock which will fasten

on the tip of the syringe by a quarter turn rather than threads for a screw tip, which requires many turns before the connection is secure

Special needles have been devised for special purposes. Curved needles for periprostatic infiltration or injecting around the base of tumors are superfluous. They are expensive, not readily obtainable on the market and easily broken. Needle holders, needles with a graduated scale and appliances for marking the depth to which the needle is passed are unnecessary. A device for marking depth much superior to the customary piece of cork is the fastener which anchors the tie pin in a necktie (Fig 2). This device will fit the average-sized needle equally as well as the tie pin and is valuable in estimating the depth in splanchnic nerve block.

Insulated needles certainly rank lowest in value among special devices. These needles, insulated everywhere but at the tip, are inserted to the approximate location of a nerve trunk then connected with a dynamo. When the non-insulated needle point comes in contact with the nerve, the electric discharge causes a contraction of the muscles supplied by the nerve, or a paræsthesia along the course of a sensory nerve. Obviously the disturbance to the patient is great and the method tedious. An accurate knowledge of anatomy would eliminate the necessity of such a procedure. The beginner will certainly do well not to attempt this method in operations on his friends.

The needles which most nearly fulfill the requirements of local anæsthesia are those sold with the Labat syringe (Fig 3). These needles are made of an excellent quality of cutting steel, are nickel-plated, semiflexible, of various sizes, and as thin as possible in proportion to the length. Each needle has a bayonet-lock at the hub and is equipped with a metallic shield to protect the point. With careful cleansing these needles can be used repeatedly, and when slightly damaged may be restored by polishing on fine emery cloth and sharpening on a hard honing stone. The spinal puncture needle is made of a nickel alloy which will bend but not break. It is more useful in spinal and sacral anæsthesia than a steel needle, as there is no danger of breakage (Fig 4). This lighter, more delicate needle is preferable to the heavy spinal trocars which are usually out of balance because of the heavy heads.

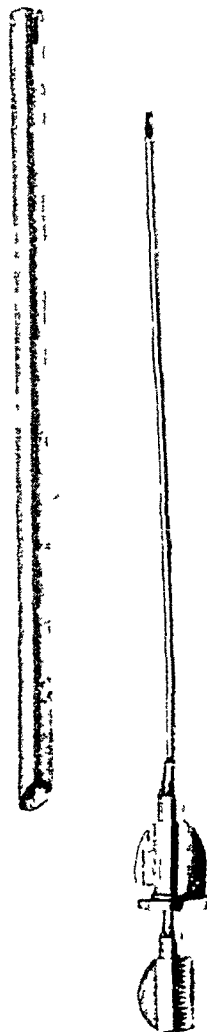


FIG 4—Nickeloid needle for spinal puncture and caudal anæsthesia

The last five years has witnessed the invention of several self-filling syringes, for all of which it is claimed that they greatly facilitate the employment of local anæsthesia. It has been my privilege to use most of these instruments, at least those advertised in the more prominent journals, and it seems doubtful whether local anæsthetic procedures, except perhaps, infiltration during operation, are at all enhanced by their use. In nerve block and other methods in which the needle must be inserted detached from the syringe they are of no value. The principal advantage is that by means of a one-way valve attached to a rubber tubing running to the receptacle of anæsthetic solution, repeated injection can be performed without detaching the needle for refilling the syringe. It has been my experience that most of these instruments are hard to manipulate, easily get out of order, and that often the one-way valve will not work, so that the solution is forced back into the container. Instruments that are equipped with but a single valve, do not expel the air from the tube efficiently and more or less air continues to collect in the syringe as the plunger is withdrawn in refilling. To be at all efficient, such syringes should be provided with both an inlet and an outlet valve, so that it may be filled without the necessity of having the needle point buried in the tissues, and all air may be excluded from the tube before the injection is begun.

The self-filling syringe which comes nearest satisfying all requirements for local infiltration is the Livingston. It is equipped with a double valve, is all metal, and contains no washers, springs or packing in the valves. It is smooth working, and provided with rings for the hand grip. A few strokes of the plunger excludes all air from the tubing and it is impossible to force novocain solution back into the container. It requires but little care and can be easily sterilized.

A very serious drawback, however, is the needle. The needles are coarse, stiff and short, resembling spinal trocars rather than needles appropriate for local anæsthesia. They are also threaded and screw onto the tip of the syringe. This feature has been improved by a device enabling the Labat needles to be used. Again with the aid of Mr. Little, the end of a broken Labat syringe was ground down and threaded to fit the Livingston syringe (Fig 5), thus discarding the coarse stubby needles, with which the syringe is originally furnished, and at the same time providing a bayonet-lock. This improved outfit, in my experience, is the most efficient of all self-filling syringes.

Pneumatic injectors as substitutes for syringes have also been devised at various times. The principle of such instruments is that of a charged cylinder. The novocain solution is placed in a cylinder under pressure and is led away by a hollow wire or tubing to a needle, the only method of controlling the flow of the solution being by means of a stopcock. Such instruments must,

of necessity, be complicated, cumbersome, and difficult to sterilize. They usually require considerable work to assemble, which means that in most cases the adrenalin cannot be added to the novocain solution just before injection.

Obviously, such an apparatus is more appropriate for infiltration than other local anæsthesia procedures. In nerve block, when the needle is introduced separately and when small definite quantities of solution must be injected slowly, these instruments are entirely unsuited. The fact that the operator does not furnish the force for the injection, and that the pressure in the cylinder is the same in dense as in loose tissues, leads to an unequal distribution of solution. The loose areolar tissues offering less resistance to injection, receive massive œdematization where indeed least solution is required. The resistance to injection sensed by the operator, when

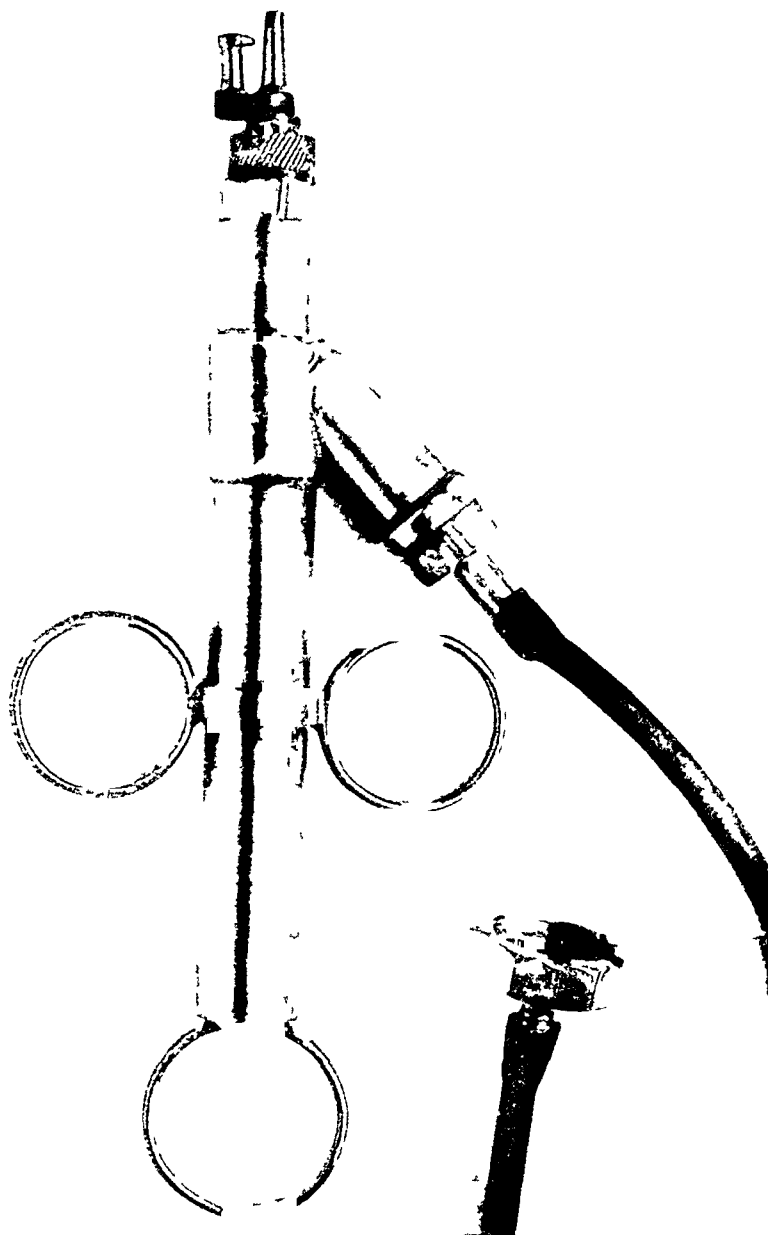


FIG 5 —The Livingston double valve syringe with an adaptor made from the tip of the Labat syringe. This device makes possible the use of the Labat needles with an automatic self-filling syringe.

employing a syringe, is often a very valuable indication as to the position of the needle point. The claim of an advantage in the pneumatic injector of not tiring the muscles is a very doubtful one. It is difficult to understand how an operator physically able to complete a major operation would be fatigued by the effort expended in manipulating a smooth working syringe. In my experience pneumatic injectors in no way simplify the employment of local anæsthetics, but represent rather the employment of a complex clumsy apparatus for the performance of a simple task.

TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting Held October 1, 1923

The President, DR JOHN H JOPSON, in the Chair

BRACHIAL PLEXUS ANÆSTHESIA FOR AMPUTATION OF FOREARM IN A PATIENT WITH ADVANCED PHTHISIS

DR ASTLEY P C ASHHURST reported the case of a woman, twenty-two years of age, who came under his care in the Orthopædic Hospital in March, 1922. She was suffering from an advanced stage of bilateral pulmonary tuberculosis, and had developed about eighteen months previously, tuberculosis of the left wrist joint, following about six months after a severe sprain. The wrist lesion had advanced rapidly, an abscess had broken more than a year previously, and four sinuses were present when first seen. The hand had been utterly useless for a year, and was constantly painful. The patient asked that it be amputated, even before the surgeon had an opportunity to explain that this offered the only chance of relief.

The pulmonary condition contra-indicated a general anæsthetic by inhalation, and as the patient was too weak to sit up, in the approved fashion for injecting the brachial plexus subcutaneously, the plexus was exposed March 25, 1922, by local infiltration anæsthesia with novocain one-quarter per cent (morphin and atropin having been given hypodermically). Incision 5 cm long above the left clavicle, fat dissected, omohyoid drawn upward, internal jugular vein retracted medially. Brachial plexus exposed, and six hypodermic syringe-fuls (about 12 c c in all) of novocain one-quarter per cent were injected among its trunks, infiltrating the surrounding fascia. The wound was closed with buried and skin sutures. The time required for exposure, injection, and closure of the wound was ten minutes.

One-half hour later, an Esmarch band was applied over a towel below the deltoid muscle, after the arm had been held elevated for a period of three minutes. Amputation was then done at the middle of the forearm. The entire procedure was painless, except retrenchment of the median nerve, which had been haggled at its primary division. A momentary sharp pain was experienced when it was drawn down and again divided. The stump was closed with buried and superficial sutures without drainage. The time required for the amputation was 15 minutes.

The patient promptly began to improve after the removal of the suppurating limb, she was able to resume her housework, but died of phthisis about a year later.

EXCISION OF A CERVICAL RIB

EXCISION OF A CERVICAL RIB

DOCTOR ASHHURST presented a woman, twenty-five years of age, who was admitted October 5, 1922, to his service at the Episcopal Hospital. Her chief complaint was pain in the left shoulder, arm and neck. Her previous personal history was irrelevant. In June, 1922, a friend called her attention to a swelling in the left supraclavicular fossa. She came to the Surgical Dispensary of the hospital on June 26, where Doctor Brown suspected the existence of a cervical rib, but when X-rays were made of her neck, neither an antero-posterior nor a lateral view showed any abnormality. In July, she began to experience pain in the arm and shoulder, and the left side of the neck felt stiff and tight from the ear down. She thought the swelling had been increasing in size, and her own physician told her the same.

Examination was negative except for the neck. In the left supraclavicular fossa, inspection showed a swelling about 2 cm above the junction of the middle with the outer third of the clavicle. Above this swelling, the jugular vein was visibly distended. On palpation the mass was found to be dense, like bone, and was round and smooth, the skin not adherent. Two bony processes extended from this mass: one went upward and mesially, and did not seem to be attached to the lower process which ran downward and mesially to disappear beneath the middle of the clavicle. A diagnosis of cervical rib was made and the patient referred for further X-ray examination by Dr. R. S. Bromer, who found (Plate 14, 143) a definite left cervical rib, which at the first X-ray examination had been hidden by the shadow of the first rib. The cervical rib ran from the left transverse process of the seventh cervical vertebra to a facet on the anterior surface of the first rib. The right transverse process of the seventh cervical vertebra was abnormally large.

Operation, October 7, 1922, intrapharyngeal ether. An incision 12 cm long was made in a skin fold about 2 to 2.5 cm above the left clavicle. The external jugular vein was doubly ligated and divided, and the posterior margin of the sternomastoid drawn forward. The omohyoid muscle was divided. The subclavian artery lying high in the neck, and running downward almost parallel with the usual course of the common carotid, was identified easily by the fact that pressure on it checked the radial pulse. It was dissected free and drawn forward. The brachial plexus was dissected free and drawn backward. Between these two important structures the most prominent part of the cervical rib was identified, covered with cartilage. The rib was thence traced backward almost to the vertebral column, and there divided with bone forceps. Next, by retracting the subclavian artery laterally over the cervical rib, the anterior end of the latter was found inserting into the first rib, beneath the clavicle, near the sternum. The lung was in plain view through the transparent pleura. It was impossible to distinguish between the lower border of the cervical rib and the upper border of the first rib. So, to make certain that all the cervical rib was removed at its anterior end, the upper border of the first rib was resected also with forceps, and the two were removed in one piece. It was then found that a movable joint was present between the end of the cervical rib

and the upper border of the first thoracic. As the rib was withdrawn from the wound, there was a sound as of air entering the pleural cavity, but no symptoms occurred. The rib was removed with its periosteum intact. The platysma and skin were closed separately. The operation lasted one hour.

There was no pain at all from the time of the operation, and at no time were there any evidences of motor or sensory disturbances from nerve injury. Doctor Ashhurst said he was rather surprised at the entire freedom from nerve lesions, as Dr Alfred S Taylor, who had reported a number of operations for cervical ribs, and who was quite accustomed to doing operations on the brachial plexus, had found them of nearly constant though usually temporary occurrence after the removal of cervical ribs. Doctor Taylor (N Y State J of Med, 1922, vol xxii, p 97) writes "The operation is difficult, is apt to be quite bloody, and is frequently followed for a varying period of time by more or less paralysis of the extremity which results from operative traumatism to the plexus. Were it not for these objections," continues Doctor Taylor, "which a review of the literature shows to be very real, there could be no question that operative treatment should be the method of choice." Doctor Taylor adds that leaving the head of the rib *in situ* has seemed to cause no late disturbance, but that it is important to remove the rib right up to the head because there might otherwise be continuing irritation of the seventh root. He points out that the shorter the rib, the more apt is such irritation to occur, because the very rudimentary ribs have their broadest surfaces in the coronal plane, with sharp borders above and below. In such short ribs, he approaches them from the lateral or posterior border of the brachial plexus, in longer ribs he excises the anterior portion first from the median side of the plexus, and then goes lateral to the plexus to remove the stump which remains.

It is true that in the present case the vertebral end of the rib had not been completely removed, a small segment still being articulated with the transverse process of the seventh cervical vertebra, but this was well above the region where the nerve caused pain from pressure on the brachial plexus.

SPONTANEOUS (?) FRACTURE OF CLAVICLE, RESULTING CALLUS MISTAKEN FOR TUMOR

DOCTOR ASHHURST also presented a boy, seven years of age, in whose right clavicle a lump had been first noticed on August 26, 1922. There was no history of any injury and there had been no disability at any time. The patient was sent by Dr A V Moschcowitz of New York, with a tentative diagnosis of malignant growth, with pathological fracture.

Examination on September 5, 1922, showed a perfectly healthy and unusually intelligent boy, physical examination of whom was negative except for the lump on the right clavicle. This was situated about 3 cm from the sternal end, was prominent, about 2 cm in diameter, attached to the clavicle, and of cartilaginous consistency, not bony hard.

CERVICAL LYMPHADENITIS SIMULATING A TUMOR

It was tender on firm pressure. Skiagraphs which he brought with him, made in New York, showed a fracture (pathological?) of the clavicle, with rather spotty looking bone. The callus or tumor did not show in the skiagraphs.

X-rays made September 11, 1922, at the Episcopal Hospital, by Dr. R. S. Bromer, showed callus forming around the fracture in fusiform shape, in excess of the normal for fracture repair, and greatly in excess of the normal for any fracture without displacement and apparently subperiosteal. Doctor Bromer, however, did not see anything which indicated the presence of a tumor.

Operation September 12, 1922. An incision 12 cm. long was made over the right clavicle, detaching the pectoralis major, sternomastoid, and subclavius muscles, without opening the periosteum. The sternoclavicular joint was opened, and the clavicle was raised, and divided at the junction of the middle and outer thirds by means of bone forceps, and the fragment was removed. A second incision, 15 cm. long, was made over the right fibula, the middle third of this bone being exposed posterior to the peroneal group of muscles. The periosteum was reflected, and an aperiosteal transplant, 7.5 cm. long, was removed by bone-cutting forceps, and the leg wound closed. The transplant was inserted in the defect in the clavicle, its sternal end being fixed to the sternum by No. 2 chromic gut sutures passed around the entire transplant and perforating the sternum. The remainder of the transplant was imbedded beneath the sternomastoid and pectoralis major muscles. Its distal end did not quite touch the scapular fragment of the original clavicle as the patient lay with his shoulder stretched over a sand bag. After closure of the incision a T-shaped splint was applied to the back, holding both shoulders back against the transverse bar.

September 18. The patient was discharged from the hospital.

October 5. The T-splint was discontinued, as the clavicle seemed to be united, and its scapular end in apposition with the transplant.

October 1, 1923. Thirteen months since operation. The right clavicle is less than 0.5 cm. shorter than the left. Its sternal end is firmly attached, but at the junction of the transplant and the scapular end there is only fibrous union. There is no pain or tenderness and no disability of any kind.

Pathological Report. The specimen, consisting of the inner two-thirds of the right clavicle, was sawed in two, lengthwise, exposing a line of fracture, with recent callus forming in excess about it. Microscopical examination by Dr. C. Y. White failed to show any evidence of tumor formation, merely normal bone with a line of cartilage traversing it, as might be seen in any uniting fracture.

CERVICAL LYMPHADENITIS SIMULATING A TUMOR

DOCTOR ASHHURST related the history of a man, thirty years of age, who came under his care in the Episcopal Hospital in October, 1922. His family and previous histories were negative and his chief complaint was a lump on the left side of his neck, and stiffness of the neck. This lump was first noted about the first of August, 1922, and was then

about the size of a pea By the middle of September, it had grown so large that he applied to the Frankford Hospital, where he was seen by Dr Chas F Nassau Doctor Nassau, according to the patient, made a diagnosis of malignant tumor, and recommended that no operation be attempted Since that time the swelling had continued to increase in size Later the swelling was submitted to an exploratory incision, nothing but blood being obtained At present there is considerable aching in the region of the tumor, and recently the patient had had numerous attacks of vertigo His best weight had been 135 pounds (61.5 kg), on admission he weighed 120 pounds (54.5 kg)

Examination showed a healthy adult male His scalp, eyes, ears and nose were normal His neck presented in the left submaxillary region a mass which extended from below the ear half-way to the clavicle protruded above the level of the mandible, and extended backward to the posterior border of the sternomastoid This mass was firm and elastic to the touch and in its upper part toward the mandible, gave an indistinct sense of fluctuation The skin was not adherent except at the site of the exploratory incision There was no edema, and only slight heat The mass was movable slightly antero-posteriorly, and less freely up and down The deep cervical lymph-nodes were palpable on both sides, and were larger on the right than the left side No submental nodes were palpable, nor were the right submaxillary lymph-nodes The temporal pulses were equal There was no indication that the mass was an aneurism

The thorax and abdomen were negative The epitrochlear and inguinal lymph-nodes were palpable on both sides of the body

In view of Doctor Nassau's opinion that the mass was malignant, a number of consultants were asked to examine the patient Doctor Nicholas, making a dental examination, reported that all the remaining teeth were in rather good condition except for stains and accretions, he found no evidence of a possible focus of infection Doctor Collins, making an examination of the throat, nose, and ears, reported them as negative for possible source of infection Dr H C Deaver, making a local examination, gave as his first diagnosis, *sarcoma*, as his second, *tuberculosis* of lymph-nodes Dr E G Alexander thought it was a growth of the lymph-nodes, of *sarcomatous nature*, but thought tuberculous infection must be considered

Operation—On October 14, 1922, operation was undertaken by Doctor Ashhurst with the diagnosis of tuberculous lymph-nodes, second choice of diagnosis, branchial carcinoma The rapidity of growth (just over two months) indicated, he thought, an inflammatory rather than a malignant tumor, although the negative exploration, and the absence of any recognizable focus of infection, were rather in favor of a neoplasm However, it was determined to conduct the operation as if the tumor were malignant With the patient in the head high position, and the neck hyperextended over a sand bag, and under ether anesthesia, an incision, 15 cm long, was made along the anterior border of the left sternomastoid muscle, an island of adherent skin, including the cicatrix of exploration, being removed with the mass The sterno-

RECURRENT KELOID OF BOTH EARS

mastoid muscle was cut across about 5 cm above the clavicle, and the common carotid artery was temporarily occluded with Crile's clamp. The tumor was dissected upward from the internal jugular vein until the latter became so densely adherent that it was cut across and tied. The submaxillary salivary gland was removed separately from the tumor, to which it was not adherent, though inflamed. This gave better exposure beneath the floor of the mouth and pharynx where the tumor extended. A few discrete enlarged lymph-nodes around the edge of the tumor were also removed with it. The superior laryngeal, hypoglossal and vagus nerves were identified and preserved, the spinal accessory nerve was not recognized. The tumor was dissected up to the base of the skull, where, in freeing it from the upper end of the internal jugular vein, the tumor was accidentally opened, with the discharge of a little creamy yellow pus. The upper end of the internal jugular vein was ligated, the resected portion being removed with the tumor. The arterial clamp was then removed. Temporary occlusion of the common carotid certainly facilitated the dissection by rendering the field relatively bloodless. The platysma was closed with interrupted chromic catgut, and the skin with equisetene, a rubber tissue drain was left at the lower end of the incision. The man made an uneventful convalescence.

Pathological Reports (Dr C Y White) From the pus encountered during operation, a smear showed no organisms, and a culture gave no growth. A guinea-pig inoculated with the tissue failed to develop tuberculosis. Histological examination showed merely chronic inflammation of lymph-nodes without evidence of any specific change, tuberculous or other.

The patient was seen in May, 1923, seven months after operation. He carried his head with the chin turned a little toward the left. At present, one year after operation, he carries his head straight, and is in good general health. The cicatrix is linear and supple. Just posterior to the scar at its upper end there is one enlarged lymph-node, about $\frac{1}{2}$ to 1 cm in diameter, and slightly tender.

DOCTOR NASSAU remarked that although Doctor Ashhurst in his history of this man had traced this case as far as Frankford Hospital, he did not go back far enough. He had an epithelioma of the lip excised at Jefferson Hospital three years before he came to Frankford Hospital, so that there was every reason to assume that the enlargement in the neck was evidence of a malignant growth, a case of recurrent carcinoma. They advised X-rays, preliminary to radical operation, but the patient refused to have this done, left the hospital and did not return. As Doctor Ashhurst notes, he has another enlarged gland in his neck, posterior to the recent dissection. It would seem as though the diagnosis of malignant growth of the neck was justified, even though the pathological examination did not find any area of malignancy.

[POSTSCRIPT] Reexamination of the patient showed a small scar on the right lower lip. Thus the patient had tried to conceal for fear if it were seen, no operation would be done. He acknowledged having been operated on by Doctor Neilson in March 1920 in the Episcopal Hospital, at which time he gave an assumed name. The records show that

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a small growth, which had then been present for six or seven years without any change in its character, was excised. Doctor Neilson's diagnosis was papilloma. The specimen was not sent to the laboratory for microscopic examination. The patient states he was never treated in the Jefferson Hospital.

The patient has promised to return after Christmas for excision of the palpable but indolent node, still present in the left neck, and a further report will then be made to the Academy. A P C A, December, 1923.]

RECURRENT KELOID OF BOTH EARS

DOCTOR ASHHURST presented a negress, forty years of age, who came under his care at the Episcopal Hospital in September, 1921. Keloids had developed in the lobule of each ear about twenty years previously, very soon after puncture for ear-rings. The keloids grew slowly, but became so large that she had submitted to an operation elsewhere in 1917. The keloids began to return almost at once, and were now larger than ever before. They formed firm pendulous masses (about 10 by 5 by 8 cm. in size) attached to the lower half of each auricle (Fig. 1) and apart from the conspicuous deformity, which she concealed by wearing a close-fitting cap covering the ears and tumors, they also incommoded her by their weight and size.

September 30, 1921, the keloid was excised from the *left* ear, leaving a defect about the size of the palm of the hand. The skin edges were undermined on all sides, thus exposing the platysma and fascia. A free transplant of fascia lata (about 8 by 5 cm. in size) was cut from the right thigh and inserted in the neck wound, being sutured with No. 00 chromic catgut to the platysma and fascia, well back from the skin edges. To close the skin a plastic operation was necessary. A flap was cut from the neck, with its base below and anteriorly, and the apex of the flap was inserted behind the auricle. In this flap were included the superficial fibres of the sterno-mastoid muscle. A small flap from the scalp had to be brought down to complete the closure above and behind the ear. The skin edges were closed with interrupted sutures of equisetene. The closure was smooth and without tension except at the lobule of the ear. This point subsequently became the seat of a slough, about 1.5 cm. in diameter. The rest of the wound healed properly.

November 1, 1921, the keloid of the *right* ear was excised in a similar manner, a free transplant of fascia lata (about 4 by 10 cm.) taken from the left thigh, being implanted, and a skin flap (about 5 by 10 cm.) being cut as already described from the neck, and turned up to cover the defect. Healing occurred without any slough, there being no tension on the suture line at any point.

Systematic exposures to the Röntgen-ray were given during the after-treatment by Dr. Ralph S. Bromer.

Photographs made one year after operation (Fig. 2) show no recurrence of keloid at all except just below the left ear, where tension was present and a slough separated. The patient's present condition, two years since operation, shows no further recurrence, except on the scalp back of the left ear, where there is slight keloid. The ear itself

A



B



C



Fig 1 —a and b Keloid of both ears, recurrent after operation four years ago c Scar of operation on left ear, twelve days before photo



Fig 2 —One year after operation for keloid of both ears, no recurrence at the end of the second year

CARCINOMA OF THE SIGMOID

is normal. Whether this freedom from recurrence is to be attributed to the implantation of the fascial transplants, thus relieving the skin cicatrices of tension, as advocated by Freeman (Colorado Medicine, 1915, vol. xii, p. 79) or to the Rontgen-ray treatment, is problematical. Certainly it is well recognized that simple excision of keloids, without any other precautions, is nearly always followed by prompt recurrence, and it is further notable that both the incisions made in this patient's thighs have developed keloids, that on the left giving her pain at times. The left thigh keloid measures 15 cm. by 17 cm., and that on the right 1 by 16 cm. These skin wounds were made in the long axis of the limb, that is at right angles to the normal skin creases, but were under no tension when sutured. Yet they were over defects in the fascia lata, which could not be closed completely after removal of the transplants and they were not subjected to Rontgen therapy.

DR. RALPH S. BROMER said that X-ray treatment is indicated in every case, except where the keloid is so large that all hope of reduction in size is impossible, owing to the extreme growth of the tumor. In such cases post-operative treatment after removal by the surgeon is the best method. In this case, 9 or 10 doses of X-ray were given in which the scar was screened very closely in order to protect the remainder of the skin. The keloid tissue certainly did not increase in size. However, in another case a small keloid of the neck, seen about two weeks after starting this one, after three treatments there was no apparent effect on the growth. This case was then referred to the surgical service and the growth was excised, fascia lata transplantation being used. After six or seven post-operative treatments the keloid recurred. Doctor McKee, of New York, has had much experience in these cases and finds very little difference between the use of radium and the X-ray, but finds the beta rays of radium very efficacious in the treatment of small keloids. Pfahler and Knox agree that after post-operative removal, treatment by radiation is always indicated. In case of small keloids radiation should first be tried.

DOCTOR DORRANCE said that in a patient at St. Agnes' Hospital who had large keloids on the chest, a test was made by applying X-ray to 1/3, radium to 1/3, and nothing to 1/3. After X-ray treatment and radium treatment of, he did not remember what exact dosage, they excised it three months later and the pathological report showed no difference between any of the three parts. After they removed it they did the same thing over again with no particular change. They thought, however, that the side to which radium had been applied had less scar.

CARCINOMA OF THE SIGMOID WITH PERFORATION OF THE CÆCUM

DR. EDWARD J. KLOPP presented a specimen obtained from a man aged fifty years, who was admitted to Doctor Gibbon's service at the Jefferson Hospital, September 12, 1923. He complained of pain and distention of the abdomen and constipation. His father died at sixty-seven of cancer of the rectum.

In November, 1922, he had a cough which lasted about three weeks, no hæmoptysis, nightsweats or pain in chest. All winter he felt weak and tired and began to lose weight. Had no nausea, vomiting, diarrhœa or increased constipation. About three months ago first noticed swelling of the abdomen which would appear and disappear. This has become worse until now it stays all the time. About six weeks ago pain gradually appeared and became fairly severe. He vomited only twice in last six weeks, rather copiously, a bitter, dark greenish material. Constipation began three months ago which later became very obstinate. At no time did he notice blood or mucus in the stools.

On examination the abdomen was found to be considerably distended, tympanitic, moderately tender over the right lower quadrant and no free fluid demonstrable. Transversely across the abdomen, immediately above the umbilicus and corresponding to the position of the transverse colon, was a mobile, fairly soft mass suggesting fecal accumulation.

Temperature, pulse and respiration were normal. He did not appear to be critically ill. Immediate surgical interference did not seem imperative.

At 4 P. M. of the following day he vomited, the abdominal pain was intense, the pulse could not be felt. There was no response to stimulation. He died at 8 P. M.

The autopsy made by DR. B. L. CRAWFORD revealed a general recent peritonitis due to a perforation of the anterior wall of the cæcum, in which part of the intestine was an area of necrosis.

The stomach and entire small intestine contained foul-smelling fecal material. The wall of the entire cæcum was dark green in color, the opening in the wall sharply defined, without any evidence of inflammation of the mucosa. No induration of the gut wall. The remaining portion of the large intestine was markedly distended with semisolid fecal material, down to the sigmoid, 30 cm. from the anus, where there was a definite constriction in the lumen of the gut, only with force could small quantities of fecal material be forced through. On sectioning the sigmoid, the constricted portion measured 2.75 cm. in circumference, a narrow portion of the gut wall is thickened and indurated.

The histologic diagnosis was adeno-carcinoma of sigmoid with metastasis to the regional and retro-peritoneal lymph-nodes. Acute fibrino-purulent peritonitis.

He presented this specimen not because cancer of the sigmoid is unusual nor that obstruction is infrequent, but because necrosis of the cæcum so far removed from the site of the obstructive lesion is uncommon. The necrosis probably was due to marked distention and weight of the heavy column of colon contents. One occasionally sees ulceration and perforation at site of malignant growth or near by on the proximal side when obstruction is almost complete and when the fecal matter is fairly hard, thus causing ulceration and possibly perforation.

Perforation apparently was not very sudden, evidenced by the closure of the opening by a coil of intestine and the absence of fecal material in the peritoneal cavity.

HYDRONEPHROSIS FROM KINKING OF URETER

DR A P C ASHHURST said that some years ago he had a patient who had an abscess around the cæcum, and came to the hospital very sick. The abscess was opened and drained, but the patient never got well and a fecal fistula developed. At autopsy a carcinoma was found at the hepatic flexure, entirely independent of the perforation of the cæcum, but which had caused the perforation, by back pressure from chronic intestinal obstruction. The carcinoma, however, was nearer the seat of perforation than it was in Doctor Klopp's case.

HYDRONEPHROSIS FROM KINKING OF URETER

DR T TURNER THOMAS reported the history of a man, forty-three years old, who three or four years ago, had a severe attack of abdominal pain in the right side of the abdomen and loin, and remained in bed three weeks. Last year he had another similar attack which kept him in bed five weeks. The pain bore no relation to meals. He never had any dysuria, incontinence, hæmaturia, or any trouble with urination. April 7, 1923, his last attack began when he became nauseated and vomited a few times. He has had no other gastric symptoms, no pain after meals, no gaseous or acid eructations, and his appetite has been good. He has had no dizziness in these attacks, no palpitation, œdema or other heart symptoms. He has not been jaundiced at any time. He was admitted to the Northeastern Hospital on April 7, 1923, the day on which this last attack began. April 9 the abdomen was opened by a right rectus incision. On introducing the hand into the abdomen for examination, an abnormal globular mass was discovered which appeared to be connected with the kidney. The abdominal incision was then closed and protected and the patient turned over into the prone position and the kidney exposed through the loin. It was delivered into the wound and the fluctuating mass explored by a needle and found to contain a fluid which was probably urine. It was then opened and found to be a dilated kidney pelvis.

The ureter immediately below the dilated pelvis was of about the normal calibre, indicating that there was an obstruction at the junction of the dilated and normal portions. It was concluded that there must be a kink here. No stone could be found in the pelvis and an ordinary (long) probe was passed down the ureter about 6 or 8 inches to where it crossed the iliac vessels and bent sharply downward into the pelvis without meeting any obstruction. In an effort to overcome the kink the ureter was divided longitudinally and an attempt made to suture this wound transversely. This was very difficult and resulted in the complete detachment of the ureter from the pelvis. The upper torn opening in the ureter was then anastomosed into the larger opening in the dilated pelvis by catgut suture, the effort being to overcome any further obstruction by uniting the small opening of the ureter all around to a larger opening in the pelvis, thus tending to hold the ureter wide open. This was accomplished fairly satisfactorily, the kidney was replaced in the abdomen, a split rubber tube with a gauze drain in it was introduced to the repaired pelvis and ureter and brought out of the lower angle of the wound, which was then closed in the usual manner. The patient was returned to the ward in a fair condition.

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April 10 The pulse which was about 60 before operation has gone up to 136, the temperature to 100.6 The abdomen is tense and tympanic and the patient breathes with difficulty He is vomiting small quantities of a dark liquid, usually turning his head to one side to spit it out He has not passed flatus, although peristalsis can be heard

April 11 Same condition as yesterday, somewhat worse

April 12 After an effectual enema to-day the abdomen became softer and the patient felt better

April 14 The improvement has continued and to-day the patient is allowed soft diet The dressings over the loin wound are dark from wound discharges, but have become dry, indicating that he has probably not been discharging urine from the wound On the day following the operation the urine was dark colored, evidently from blood, indicating that he was already passing urine freely through the anastomosed ureter and kidney pelvis

The patient continued to improve and was discharged April 25 At no time after the operation did he show any evidence of obstruction to the urine He went back to work about four weeks later and has continued to do so since, according to his statement when last seen, about the middle of August, and by the statement since then by his physician, Dr W Drummond

CHORIO-EPITHELIOMA OF THE UTERUS

DOCTOR THOMAS detailed the history of a woman, twenty-seven years of age, who was admitted to the Northeastern Hospital, July 29, 1923, on account of a metrorrhagia which had persisted for about ten weeks Three years before she had experienced a similar trouble, which was relieved by a curettement In the interval she had been perfectly well

July 31 The cervix was widely dilated and the finger introduced, but could not reach the fundus nor feel anything pathological The dull curette detected on the posterior surface of the uterine cavity near the fundus on the left side, a small, rough, gritty surface the scraping of which produced a peculiar tissue, which was rather tough and fibrous and had a somewhat cauliflower appearance To stop the free bleeding the uterus was irrigated with a hot solution and packed with sterile gauze, which was removed on the following day

August 3 The pathologist, Dr William Spaeth, reported that the specimen showed a chorioepithelioma

August 4 A supravaginal hysterectomy with a bilateral salpingo-oophorectomy was performed The specimen consists of the uterus, both tubes and ovaries The uterus is about twice the normal size and is soft and boggy Both tubes and ovaries show no abnormalities Opening the uterus anteriorly there is found a reddish-blue mass situated on the posterior wall of the fundus, soft and friable and intimately attached to the uterine endometrium It is about 3 cm in diameter and spherical in outline A section taken for diagnosis, upon microscopical examination, showed a cellular extension taking place in the blood sinuses and irregular masses of nucleated protoplasm formed by syn-

RAPID REGENERATION FOLLOWING FACIAL NERVE SUTURES

cidial cells Many smaller cells resembling endothelial cells and some similar to lymphocytes are also present In addition there is found some myxomatous degeneration Diagnosis Chorioepithelioma of the uterus

The patient was discharged August 16 and has remained well since

DR A P C ASHHURST said that in 1919, he reported to the Academy the case of a woman who was then well and healthy six years after a hysterectomy for chorioepithelioma He had written her again and the letter was returned, marked removed, which did not seem to imply that she was dead If she still lives it is now ten years since her operation (NOTE Since this discussion, the patient has been traced by the Social Service Department of the Episcopal Hospital, and is in perfect health still)

He thought it to be very important for anyone who has to evacuate the uterus after a miscarriage to have the tissue examined in the laboratory In this case there was nothing grossly abnormal in the tissue, but the report from the laboratory came back in nine days and the next day the hysterectomy was done Though this laboratory examination has been made as a routine since then in all cases, they have not found another case of chorioepithelioma, though such a diagnosis has been made twice erroneously from the gross specimen

RAPID REGENERATION FOLLOWING FACIAL NERVE SUTURES

DR E L ELIASON presented a woman who in the evening of April 11, 1923, sustained in an auto accident a jagged incised wound in front of the right ear extending from just above the tragus down to the angle of the mandible This incision severed the facial nerve, the parotid gland and the masseter muscle There was complete paralysis in the right facial nerve distribution Other injuries to face, lip and teeth were present

The wound was cleaned and the nerve which was severed just before it broke up into its division was sutured with 000 silk The parotid was sutured and a small rubber wick placed in the lower angle of the wound

April 17 She was discharged, wound having healed per primam Facial paralysis still present

April 30, 1923 A dentist who is at work on her teeth reports return of power to retract the angle of the mouth

Neurological Report by Dr George Wilson The first electrical reactions were made seventeen days after the injury and showed no reaction to faradism and reactions of degeneration to galvanism Twenty-three days (May 4) after the accident there was a slight return of motion at the angle of the mouth and a strong faradic current produced slight reaction She was treated with electricity, galvanism at first and later faradism two or three times a week until the first of September

The return of power in the lower part of the face was quite rapid, but very little if any recovery has taken place in the upper branch of the seventh nerve About the first of August she first began to show some movements in the lower part of the face when the eye was winked and

also movements of the eye when the lower part of the face was moved. This is probably due to the fact that some of the fibres in growing distally lose their way, those which should go to the upper part of the face going to the lower and those which should go to the lower part of the face going to the upper.

DR CHARLES H FRAZIER said that he was particularly interested in whether it was physically possible for nerve restoration to take place with return of function in twenty-four days. Estimating on the basis that nerve regeneration occurs at the rate of $1\frac{1}{2}$ cm per week, it is quite possible for new axes to have grown down in this case from the point of injury to the end muscle within the specified time. A point which had occurred to him was whether or not it was possible to revise the laws of physical repair in cases of nerve injury because it is generally understood that after complete dissolution before regeneration takes place, degeneration takes place in the duct. If that were true it would hardly be conceivable that function could be restored within the specified time. He had no recollection of any other case which recovered as rapidly as this.

Concerning the return of function in the occipital frontalis, for some reason or other this frequently occurs.

DOCTOR ELIASON added that he had no especial difficulty except in finding the proximal end of the nerve. He put three fine silk sutures in it and obtained good approximation. There is no doubt about the fact that the nerve was cut, and that the return of function is authentic. Doctor Frazier had said he had never heard of a case being as rapid. Doctor Spiller, also, thought it very unusual, but said he had never heard of the facial nerve being sutured within one hour of the injury to it, and thought this might have something to do with the rapid regeneration.

TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

Stated Meeting Held October 10, 1923

The President, DR EUGENE H POOL, in the Chair

PENETRATING ULCER OF THE LESSER CURVATURE OF THE STOMACH, BILLROTH II

DR RICHARD LEWISOHN presented a man, thirty-nine years old, who was admitted to Mt Sinai Hospital June 20, 1923. There was a two months' history of upper abdominal cramps and of nausea. There had been no vomiting. The Ewald test-meal showed free HCl 45, total acidity 83. X-ray examination showed a penetrating ulcer of the lesser curvature above the reentrant angle.

Doctor Lewisohn stated that in ulcers situated in the proximal half of the stomach, it might be of importance to visualize, on the X-ray picture, the distance between the cardia and the ulcer. Although the usual X-ray picture outlines the stomach, it does not give any information as to the exact location of the cardiac opening. By using a nasal feeding tube, in combination with a ureteral X-ray bougie, he had been able in a number of cases to visualize the cardia on the roentgenogram.

At operation June 30, a small ulcer (size of a dime) was found. A subtotal gastrectomy was performed, from a point proximal to the ulcer to beyond the pylorus. Both ends were closed and stomach and jejunum were united by a Murphy button. The patient made an uneventful recovery. He was discharged July 24. The button was passed four weeks after the operation. Microscopic examination showed a benign ulcer. The patient has gained 35 pounds since his operation and feels perfectly well. The stomach empties so rapidly that it was impossible to get stomach contents for chemical analysis, though the tube was passed 30 minutes after the test-meal had been taken. X-ray examination (October 8) shows that the stomach empties rapidly, no residue after three hours.

DUODENAL ULCER, BILLROTH I

DOCTOR LEWISOHN presented a man, forty-two years old, who was admitted to Mt Sinai Hospital July 23, 1923. He had suffered from intermittent epigastric pains for six years. These pains had become very severe during the last week before his admission. The pains were relieved by vomiting. Ewald free HCl 68 total acidity 89. There was some tenderness on pressure in the right epigastrium. X-ray examination showed an irregular duodenal cap, marked hyperperistalsis and a residue after six hours. Diagnosis: duodenal ulcer.

Operation (July 28) revealed a small thickened area in the first part of the duodenum on its anterior wall. The thickened area was about

one-half inch long A crater could not be felt A partial gastrectomy was performed, including the diseased area of the duodenum and about 8 cm of the distal portion of the stomach The two ends were reunited by using the Haberer modification of the Billroth I technic The abdomen was closed without drainage

Microscopic examination showed a superficial callous ulcer, not entirely healed The patient made an uneventful recovery Ewald test-meal taken sixteen days after the operation, showed free HCl 25, total acidity 66

The patient was sent home three weeks after operation He feels perfectly well now and has gained 11 pounds in six weeks

X-ray examination (October 8) shows that the stomach empties rapidly, no residue after three hours

PERFORATING GASTRIC ULCER

DR HUGH AUCHINCLOSS presented a man, fifty years old, who had been treated for nine years in the Out-patient Department for supposed chronic pulmonary tuberculosis He was a cigarmaker and smoked heavily Didn't drink For seven years he had had mild gastric symptoms Attacks of epigastric discomfort and pain three to six hours after meals for two months at a time with free intervals of six or seven months definitely worse during the past two years He has had acid regurgitation and substernal burning For two months has not only had a poor appetite, but has been afraid to eat, so that he has lost 15 pounds in two months and become very weak and discouraged The stools have been dark for two weeks and for the past week he has vomited several times, brownish material, especially at night

His first admission was on February 9, 1923, eight months ago There was tenderness and visible peristalsis in the epigastrium He had bad teeth, a short systolic murmur at his apex, but his lung signs were negative There was a slight leucocytosis, 10,500, polymorphonuclears 78, and his red count showed 4,700,000 Hæmoglobin 80 Wassermann negative Blood urea 28 gms per litre Blood CO₂ 49 volumes per cent Fasting expression showed blood, free HCl 50, total 95 Test meal free HCl 57, total 67 A niche was described by Doctor Golden as present at the pylorus, probably on the gastric side, with persistent incisura opposite

From February 9, he remained in the ward on a selected diet for twenty-four days He lost his pain, all his symptoms disappeared, and he gained 12 pounds He was advised to have an operation, but felt so well that he decided to go home on his own responsibility, signing a hospital release slip

Three weeks later he reported at the Follow-up Clinic with no gastric symptoms, eating four meals a day as outlined for him by Doctor Bauman He had gained about 15 pounds more, was working regularly and on the crest of the wave A note made at that time states our conviction that he would have a recurrence He was warned several times to report at once on the onset of pain or signs of hemorrhage

One morning, thirty-seven days later, he came to the Out-patient Department, having two days previously, slight epigastric discomfort. About six hours previously had awakened at 3 A M, vomiting a very large amount of brown, soupy fluid described as at least two quarts. This was repeated in smaller amounts, up to 9 o'clock in the morning, when he came to the clinic. He was seen in the Emergency Ward by the House Surgeon, who found that there was slight tenderness, no rigidity, no evidence of free fluid, but leucocytes 18,200, polymorphonuclears 85 per cent. He was sent to the ward.

Just as he was being put to bed he began having very violent pain in right lower chest, epigastrium and right side of abdomen, much worse with motion, causing him to cry out and groan and beg for help. Rigidity and tenderness became evident, but the signs were not as diffuse as is generally seen. They were mostly in the right upper quadrant as in a localized peritonitis. There was a readily appreciated absence of liver dullness. The heart and breath sounds could not be heard over abdomen. On his way to the operating room, an effort was made to show an air shadow over the dome of the liver by taking an X-ray plate in as erect position as possible, but nothing was demonstrable.

He was operated on within an hour of his perforation. There was much air and brown fluid in the upper abdomen. Peritoneum was injected. An ulcer opening about 5 cm in diameter with some induration about it appeared at the pylorus, it was thought on the gastric side. This was sutured with three Halsted mattress sutures taken from below upwards and then two from stomach to duodenum. A posterior short-loop gastro-enterostomy was done, suturing without clamps and a button jejunostomy performed by inserting one-half the button in either limb when the jejunum was open during the gastro-enterostomy.

The post-operative course was uneventful. There was no pain, distention, vomiting or bleeding.

The Murphy button was lost in one of the enemata. It was seen by X-ray first on the seventh day, and again on the thirteenth day, over the sacrum, but was absent when plate was taken on the twenty-fifth day.

Four and one-half months later he weighed 128 pounds, and reports free of symptoms. The interesting features in this case are: 1. Nine years considered to have tuberculosis, whereas he had mild gastric disturbance seven years. When admitted, no active tuberculosis signs could be found. 2. Tenderness occurring on first admission as a suggestion that the ulcer was perforating. 3. Early loss of liver dullness. 4. Absence of heart and lung sounds over abdomen with perforation. 5. Inability to demonstrate gas in peritoneum by X-ray after perforation but before operation. 6. That he should have perforated under immediate observation while in the hospital providing a somewhat exceptional opportunity for noting early physical signs and pathology.

Reexamination of the stomach five months post-operative showed an apparently normally working gastro-enterostomy. No barium passed spontaneously through the pylorus. There was no six-hour gastric residue. The antrum seemed to close off quite well but there was slight irregularity on the lesser curvature apparently just above the pylorus,

which might be due to the crater of an ulcer. If this does represent an ulcer crater, it is very small, and looks nothing like what was seen at the previous examination. The duodenum was not satisfactorily seen, as little barium could be expressed through the pylorus.

FINNEY PYLOROPLASTY FOR PYLORIC STENOSIS

DR JOHN C A GERSTER presented a man of thirty years, who was admitted to Mount Sinai Hospital, August 25, 1923 (Service of Dr A A Berg). There was epigastric distress for five years previously occurring one and one-half to three hours after meals, accompanied by nausea and pyrosis, no vomiting, lost 12 pounds in two years. Except for slight icteric tint, physical examination was negative. Ewald test meal of 6 ounces showed, 54 free acid, 70 combined acid. X-ray (August 27) showed increased peristalsis, duodenal bulb irregular at all observations, large residue after six hours, moderate residue after twenty-four hours. Wassermann negative. At operation (August 29) pyloric stenosis was found due to a stellate scar on anterior surface of first part of duodenum. Many adhesions around gall-bladder present. Typical Finney pyloroplasty. Uneventful convalescence except for congestion of right lower lobe for two days after operation. Discharged on the eighteenth day. October 8, forty days after operation, X-ray examination showed good tone and peristalsis. No residue at six hours. October 9, test meal showed free acid 58, combined acid 74. Has gained 18 pounds.

CASE II. A man, thirty-eight years old, was admitted to Mount Sinai Hospital, April 20, 1923 (Service Dr A A Berg). He complained of stomach trouble for two or three years, a series of attacks of epigastric pain lasting a few days at a time and accompanied by pyrosis and vomiting had occurred. Between attacks he felt well. Last attack two weeks before admission. Lost 10 pounds in six months. Physical examination showed an emaciated, anæmic man with slight cyanosis. Otherwise physical examination was negative. X-ray examination April 23, showed extreme gastrocoloptosis. Duodenal bulb irregular at all observations. Increased peristalsis and slight delay in motility. Only one ounce of Ewald test meal was obtained. Free acid 5, combined acid 10. Wassermann negative. At operation April 28, a small callous ulcer of anterior surface of first portion of duodenum, one-quarter of an inch in diameter, was excised in the course of a typical Finney operation. Discharged on the seventeenth day after operation. Specimen excised reported by pathologist to be a typical callous ulcer.

X-ray October 8, 1923, more than five months after operation, showed good gastric tone. Peristalsis not increased. At first, no food passed through opening for ten minutes, then it began to go through slowly. At six hours there was a small residue in the stomach, one-quarter of the meal in the ileum the rest in colon. October 9, test meal showed free acid 45, combined acid 60. Has gained 12 pounds.

CASE III. J A, a man, forty-three years of age, was admitted to the Lenox Hill Hospital, July 4, 1922 (Service of Dr DeWitt

CONGENITAL CYST OF THE COMMON BILE DUCT

Stetten) He gave a history of twenty years' chronic indigestion with pain one hour after meals. In 1914, had a gastric hemorrhage. Four hours before admission, experienced sudden intense epigastric pain with vomiting. Physical examination showed a thin man with board-like rigidity of abdomen who evidently was suffering from acute perforation of the stomach. At operation, the perforation, 3 mm in diameter on the anterior surface of the stomach near the pylorus, was closed with a silk mattress suture. Much free glairy fluid in the peritoneum with some gas, pelvis drained through a suprapubic stab wound. Uneventful convalescence. Discharged August 8. X-ray at that time showed marked ptosis. Stomach empty in six hours.

Re-admitted about one year later, August 11, 1923, stating that during the past few months there had been gradual development of pain after eating, vomiting of food eaten several days before, considerable loss of weight.

Physical examination revealed an emaciated man with a dilated stomach (clapotage) and a healed right rectus epigastric scar. August 14, X-ray examination showed 24-hour residue in stomach larger than immediate filling, probably due to admixture of food. Greater curvature of stomach in pelvis.

August 16, at operation, silk mattress suture found embedded in anterior wall of stomach at site of former perforation. No induration here. When stomach was opened in the course of pyloroplasty, mucosa at site of former perforation exposed and found normal.

September 5, stomach empty in three and one-half hours. Discharged same day, after uneventful convalescence.

October 10. Has gained 30 pounds since operation.

CONGENITAL CYST OF THE COMMON BILE DUCT

DR RICHARD W. BOLLING presented a specimen of a congenital cyst of the common bile duct. The specimen was removed from a six months' female infant at autopsy, eighteen days after operation. The history was of normal birth and development until three months, when the mother noticed that the eyes were becoming yellow, the child, however, continued to nurse well and the stools were yellow or green. Shortly after an increase in the size of the abdomen was noted and the urine became very dark.

The child was admitted to Saint Luke's Hospital, June 19, 1923, when five months old, being referred to the pediatric service by Doctor Calhoun. During its stay in the hospital its stools varied in color from white to yellow or green, but in spite of repeated examination bile was never demonstrated. Shortly after admission Doctor Bolling saw the child in consultation and found an emaciated female infant with jaundiced sclerae. Occupying the upper abdomen was a globular cystic mass about three and one-half inches in diameter, extending downward from the under surface of the liver. The liver edge could be demonstrated above and the outline of the right kidney behind and to the outer side. Rontgen-ray examination made at this time showed a shadow of increased density occupying the right portion of the abdo-

men The duodenum was apparently stretched over the summit of this mass and the small intestine and colon were displaced to the left. Lateral exposure showed the stomach extending anteriorly to the abdominal wall, lying almost at right angles to the spine.

The possibility of cyst of the common duct was suggested and operation advised, which was carried out July 6, after transfer to surgical division A.

A large cystic mass was found pushing forward the pyloric end of the stomach and the duodenum, which latter was stretched across the top of the cyst and flattened out like a ribbon. The gall-bladder appeared normal and communicated with the cyst by means of a patent cystic duct. No communication with the duodenum could be made out. The contents of the cyst, about sixteen ounces of yellow fluid, were evacuated and an anastomosis with the duodenum effected. The fluid gave a positive test for bile and contained much bile pigment. The wound was closed without drainage.

The child did well for ten days, but then began to fail, and died on the eighteenth post-operative day. Following the operation the stools varied in color from clay to green, but bile was never present. At autopsy the cyst was found much contracted and empty. The stoma was patent, but there had apparently been no secretion of bile. The condition of the liver evidenced an advanced state of biliary cirrhosis. The cyst consisted of a dilatation of the common duct. The openings of the hepatic and cystic ducts could be made out, but there was no demonstrable communication with the duodenum other than the artificial stoma made at operation. The opening of the pancreatic duct into the duodenum could be demonstrated.

The condition is one of considerable rarity. In an article in the British Journal of Surgery, in January of this year, Morley reports two cases and refers to thirty-nine in the literature. The condition usually occurs in females and the average age is twelve to fourteen years. An instance has been noted in the fetus and one case is reported in a man of fifty-six who had had trouble since his twentieth year. The diagnosis is usually a matter of some difficulty. The rational treatment appears to be choledocho-duodenostomy without drainage.

ACUTE PERFORATED ULCER OF THE STOMACH AND DUODENUM

DR JOHN A. MCCREERY read a paper with the above title, for which see page 91.

DR CHARLES L. GIBSON admitted that the case for gastro-enterostomy is gaining adherents and that there are many people who can be benefited by this operation, but he felt that more of these cases of perforation would be saved if the surgeon confined himself to the immediate emergency. He believed that if 1000 cases were operated on by a simple procedure and 1000 by gastro-enterostomy, one case at least would die in the gastro-enterostomy series and this thousandth case was worth saving. He felt much as Panchet said: "If it is left to the patient he will prefer to be saved in two stages rather than to be killed in one." Nobody could lay

down the law to experienced surgeons and many gastro-enterostomies were done wisely, but it had so happened that in the speaker's personal experience only one gastro-enterostomy had seemed necessary. It had been said this evening that he had reported, 10 per cent of his cases required reoperation. He thought it fair to reply that if a surgeon has a relatively small primary mortality he will have more candidates for trouble. The question of how much stenosis is produced by the ulcer or cicatrization requires a little judgment. In many cases the stenosis involves only one side, it is not a circular contraction, and there is subsequent disappearance with the healing of the ulcer. The elimination of slough brings about the healing of the ulcer. Consequently, one should exercise a little discretion. Gastro-enterostomy in the body of the stomach does not result well and has some drawbacks.

DOCTOR GIBSON presented another argument, to wit. If a surgeon postpones operation he may be able to do a better, wiser, and more radical operation than gastro-enterostomy. The tendency of the times is for more and better surgery, and leaving an ulcer behind or doing an operation not involving the destruction of the ulcer is a confession of failure. Surgeons of great experience are now performing operations on duodenal ulcers that the speaker would not have believed possible a few years ago.

As to the question of referred pain, Doctor Gibson thought a history of it could often be elicited. He had seen patients with pain in the right shoulder, in one it was at the base of the neck. The elicitation of a history of this pain is interesting. It is short-lived, comes on early after perforation, lasts only a few minutes, and then goes away. Meanwhile the greater pain goes on and the patient forgets the lesser one. Recently, a patient who was asked about this clavicular pain denied it, but when convalescent he recalled having had the pain. The speaker believed this pain to be absolutely diagnostic.

DOCTOR GIBSON then described three technical procedures which he believes are of value.

- 1 Patient should be given a swallow of colored fluid, such as methylene blue, as this facilitates locating the perforation easily.

- 2 Opening the peritoneum under water. If a bubble of gas escapes the diagnosis becomes absolute.

- 3 When the application of sutures is likely to cause constriction, real or apparent, interrupted sutures are used and the line is made vertical to the axis of the duodenum or the pylorus (Hemeke-Mikulicz technic). Constriction is reduced to a minimum.

- 4 Analysis of 78 cases shows the value of early operation. In the 18-hour period are included two cases that died of conditions independent of the operation. One a man who got out of bed the night after the operation, drank a lot of water and collapsed, temperature of 105°, œdema of lungs, and prompt death, autopsy showed an irreproachable condition. The second case died forty-five days after the original operation and twenty-three days

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after an operation for empyema, autopsy showed no connection with the abdominal condition

SUMMARY OF SEVENTY-EIGHT CASES OF ACUTE PERFORATION OF STOMACH AND DUODENUM

Cases	Perforations hours	Deaths	Per cent
59	12	4	6.5 (3.2)
2	18		
5	24	1	20.0
12	Over 24	8	66.6
Total mortality, 16.6 per cent			

DR ALFRED STILLMAN said that in his personal cases absence of liver dulness had been frequent, and a distress more marked than in cases of appendicitis, amounting to shock, often suggested the diagnosis. About one-half of the cases closed had to be reopened, however, he preferred to close the peritoneal cavity without drainage.

DR ROBERT T. MORRIS agreed with Doctor Gibson that one ought not to do more work than is actually necessary in these cases, he personally went a step further by simply making a short incision quickly, introducing a drain, putting the patient upon the Alonzo Clark opium treatment and then reserving further operative work for a more appropriate time with the patient in better condition.

Doctor Morris had arrived at this position in a natural sort of way. Forty years ago there were few surgeons outside of the big cities. Men from New York were more frequently called to long distances for cases of gastric or typhoid perforation. Sometimes the patients were dead, but sometimes they were better. These latter were the ones who had to be accounted for. Why were they better? The question of natural protective resources of the individual appeared. Carrying this idea to its logical conclusion, Doctor Morris, who had formerly used the short incision and drainage tube in desperate cases only, moved up to the point of using this method in cases that were not so serious, with notably good results. Later he had done all of the modern operations—gastro-enterostomy, and partial gastrectomy. He had now gone back to the simplest, quickest drainage operation and to the Alonzo Clark opium treatment, reserving a severe operation for a later date and often finding it unnecessary.

Not quite enough had been said in this discussion about the persistence of original causes after operation for gastric ulcer. These must be looked for in focal infections or peripheral irritations and must be eliminated. For example, in the second case shown by Doctor Gerster, the patient was evidently suffering from heterophoria. The correction of heterophoria by a proper authority might result in complete disappearance of gastric or duodenal symptoms. Doctor Morris worked more and more in harmony with the internists in cases of midgut ulcer, doing less and less surgical work.

DR JOHN DOUGLAS said that the matter of what should be done in the way of more than closure of the perforation seemed to be the main question open to discussion. He believed that in most cases of perforated ulcer, closure of the perforation was all that should be done. But that if a surgeon starts an operation with the set and fast idea of what should be done in every case, he will not always get the best results. There are the late cases in which the mortality is always high and in which it is generally conceded one should do no more than close the perforation. In a few other cases it is still debatable if it is wiser to do more. In a small number it is possible to burn the ulcer out, then do a closure. Many of these patients have no further symptoms. But there are other cases in which the ulcer which is perforated is greatly indurated directly at the pylorus and can be closed only with difficulty and leaves considerable deformity and constriction. In these cases, if operation is done within the first few hours after perforation, when there is little peritoneal soiling and the patient's condition is good, a gastro-enterostomy can be done after closure with little if any increase of mortality and a far better prospect of cure of the patient. Doctor Gibson argues that if 1000 are closed with gastro-enterostomy and 1000 are closed without it, if there is one more death from the more complicated operation, the simpler operation should always be done. On the supposition that this is true, out of 1000 simple operations, 100 patients will have to be operated on again according to his statistics and far more according to the figures of Doctor McCreery, and as there is a mortality of about 3 per cent following simple gastro-enterostomy from avoidable complications, the number of deaths from this second operation must be taken into consideration before accepting his reasoning.

As far as Doctor Lewisohn's case is concerned, Doctor Douglas could not see why three-fourths of the stomach should be taken out for an ulcer the size of a ten-cent piece. Burning out the ulcer with a cautery, followed by gastro-enterostomy would have given, he believed, good results. Simple excision in the second place would have given a good prospect of cure. Doctor Douglas did not consider that the criticisms of gastro-enterostomy were entirely justified. The follow-up clinic at St. Luke's did not show these bad results. As far as the Finney operation was concerned, Doctor Douglas believed that there were a number of cases where the induration and the extent of the ulcer made the Finney operation very difficult or impossible to do, but where the ulcer was close to the pylorus or a healed ulcer caused obstruction of the pylorus, it gave excellent results.

DR WALTON MARTIN said he regarded statistical information as unsatisfactory as in many instances dissimilar cases were grouped together. It is the general experience borne out by Doctor McCreery's series as in all others, that the time factor is of the utmost importance. He hardly thought Doctor McCreery would be in favor of gastro-enterostomy in the cases with well-established general peritonitis nor in favor of gastro-enterostomy in ulcer of the body of the stomach.

The question therefore was whether or no a gastro-enterostomy should be done in early cases of parapyloric perforation and Doctor Martin believes it rather confusing for Doctor McCreery to include cases outside this group and that it was slightly misleading to state in his resumé that gastro-enterostomy has not affected the mortality. It seemed fairer to state that gastro-enterostomy in suitably selected cases has not affected the mortality. This question, as many another in surgical practice, will always in the end hang on the individual judgment and disposition of the surgeon.

DR EUGENE H. POOL said that a striking fallacy pervades all discussions in regard to gastro-enterostomy for perforated ulcers of duodenum. Namely, an evident impression in the minds of many surgeons that a gastro-enterostomy is a thoroughly reliable and harmless procedure. In reality it must be recognized that every patient with a gastro-enterostomy is handicapped. In about 20 per cent of gastro-enterostomies symptomatic disturbances occur, and in two to three per cent of cases a marginal ulcer develops. The latter condition is about as distressing to the patient and as troublesome from the operative point of view as is any gastric condition. One should therefore not feel that in adding a gastro-enterostomy a harmless procedure has been performed. A gastro-enterostomy should always be avoided if this can properly be done. It should not be performed because it can be safely carried out technically. Of course, in early cases where the inversion of the ulcer obstructs the pylorus, or in large callous ulcers, a primary gastro-enterostomy is indicated. But in the vast majority of cases closure of the ulcer will affect an immediate cure. If such cases are carefully watched after the operation, indications for gastro-enterostomy will develop in a considerable proportion on account of gradual pyloric obstruction. Gastro-enterostomy may then be done with relative safety and under definite indications. This appears better than subjecting all cases to gastro-enterostomy at the initial operation.

DOCTOR LEWISOHN, in concluding the discussion, said that in former years he had hesitated to sacrifice large parts of the stomach when the ulcer was very small. The final results following partial gastrectomies, however, had proven far superior to those following more conservative procedures in the treatment of gastric ulcers.

DOCTOR AUCHINCLOSS, answering a question regarding jejuno-jejunoscopy, said he was not sure he had been right in doing this. So far, cases had done well where it had been used. It should be remembered that it was a procedure that made gastro-enterostomy successful in the "long-loop" days. He agreed with Doctor Pool that gastro-enterostomy was by no means a completely successful operation, even in duodenal ulcer cases. The speaker said he knows one well-known surgeon who has been doing antero-enterostomy in all his gastro-enterostomy cases for over fifteen years and believes it has lessened the follow-up discomforts in his cases. This, however, was rather contrary to the more recent notions as regards the alkalinity of the small

intestine being of benefit when it gets into the stomach, which theory is not convincing and is a matter calling for further observations

DOCTOR MCCREERY said that he fully agreed with Doctor Stillman that drainage was very rarely necessary in early cases and when used could usually be limited to drainage of the abdominal wall. Doctor Pool had spoken of the danger of the development of marginal ulcers following gastro-enterostomy. Doctor McCreery realized that marginal ulcer must always be borne in mind as a possible and, perhaps, the most serious complication of gastro-enterostomy. This had been emphasized by the fact that, during the period covered by the paper, two cases of acute perforated jejunal ulcer following gastro-enterostomy had been admitted to the division. However, he felt that there were two factors which should in future diminish the frequency of this complication. In the first place, the more accurate hæmostasis and separate mucous membrane suture made possible by operating without clamps, and in the second place a more careful control of the patient after his discharge from the hospital with particular reference to diet, made possible by improved methods of follow-up. Doctor Douglas had emphasized the point which Doctor McCreery felt was of most interest, which was that each perforated ulcer should be considered as an individual problem. There was general agreement that nothing but closure should be done in late cases or for those in poor condition but in early cases there was considerable leeway. Unquestionably, many of the soft ulcers would be cured permanently by simple closure, but callous ulcers presented a different problem, and it was in these cases that a gastro-enterostomy or, possibly, an excision and pyloroplasty, should be considered in an effort to diminish the high percentage of secondary operations necessitated by simple routine closure of the perforation.

BOOK REVIEWS

CLEFT LIP AND PALATE By TRUMAN W BROPHY, M D P Blakiston's Son and Co , Philadelphia, 1923

In 1915, Doctor Brophy's Oral Surgery was published, and this contained his work on Cleft Lip and Palate. The present volume considers these two subjects alone, adding to his previous publication the results of more recent investigations and inventions, with the improvements in technic that have been made. One can only feel the greatest admiration for what Doctor Brophy has done in this difficult work with his immense experience.

The general apathy and ignorance of medical practitioners, in regard to this subject, is explained by Doctor Brophy to be due to the fact that in 1915, only six out of sixty-four leading medical colleges of our country had chairs on Oral Surgery. Patients with these lesions are usually referred to the General Surgeon, whose interest in them is as slight as his special knowledge of the defects to be corrected.

There should be special hospitals for these patients in all our centres, under the charge of an expert thoroughly familiar with the varying anatomical formations, and the necessary technic for correction. These lesions belong essentially to the specialist. The general practitioner will have to be educated along lines advocated by Doctor Brophy, whose views are more and more prevailing. The main object of closing a cleft palate is to obtain perfect speech, but how seldom this is obtained in the late operations, usually performed where the cleft has been allowed to widen, and the defect is only closed by soft parts. Doctor Brophy maintains that to obtain perfect speech, it is necessary, in very early life, to correct the spreading of the tuberosities of the superior maxilla, and that the defective speech is only secondarily due to the atrophy of the palatal muscles. The method to bring the bones together, at the earliest possible moment after birth, is Doctor Brophy's signal contribution to cleft palate surgery. This should be done, if the cleft of the palate is complete, before the fifth month while the bones are soft. Two months or later, after the union of the bones, the lip is united, and the soft palate is closed from the sixteenth to the twenty-second month, just before the child begins to talk. The very early closure of the cleft hard palate has been objected to by others, because of the alleged increased mortality due to the operation, but Doctor Brophy maintains that the death rate of children with unoperated, cleft palate is much higher than of children with normal palates, and that the deaths resulting from this operation, are less than this increase. Doctor Brophy's reasoning seems sound, and one can only explain the lack of enthusiasm on the part of the profession to embrace his views by the failure to apprehend the minutiae of the operation. It is a highly technical procedure. The obstetrical medical practitioner must be educated to send these little patients, just as early as possible after birth, to a surgeon who knows how to

close the bones, according to the Brophy technic, and not wait for months, until the bones are thoroughly ossified, as is the customary procedure now. In a cleft lip with a cleft palate, the nose is always deformed, and, by first bringing the bones together, the nasal deformity is usually fairly corrected.

Before operating upon a cleft lip, after the hard palate has been closed, if the nose is broadened and flattened, it should be given its proper form by appropriate measures which are fully described and illustrated. Then follow descriptions of operations to cure the various types of cleft lip with explanatory pictures. Doctor Brophy says that hare lip is a misnomer because it does not resemble the lip of a hare whose cleft is in the median line. He prefers to call it cleft lip. He has eschewed all other methods, previously used, to prevent the separation of the sutured edges of the cleft lip, except Doctor Logan's lip traction bow which is described on page 24. With this appliance, tension on the lip may be increased or diminished at will, which is not possible with any other device. The procedures for closing cleft lips are simple and are fully described. Protruding, premaxillary bones should never under any condition, be excised. The vomer should be obliquely split and the premaxillary bone forced backward and held in place by silver wire sutures against the maxillæ. The edges of the premaxillary bone where they approximate the maxillæ, should have all the intervening soft parts removed, and the same is true of the maxillary bones. Non-union is due to the interposition of soft tissues and failure to immobilize. A normal, maxillary arch can be secured only by treating the parts in the same manner as one would an ununited fracture. Excision of the premaxillary bone leads to a very ugly deformity, recession of the upper lip, frequently combined with a marked contraction in width of the upper lip, in comparison with which, the lower lip seems to be relatively very prominent and thick. To correct this deformity a V-shaped portion of the lower lip is removed and added to the upper lip by means of a pedicle. This procedure is fully described and illustrated by photographs.

Among 2676 cleft palate operations performed by Doctor Brophy up to 1921, there were 125 deaths, or an operative mortality of only 4.67 per cent.

Brophy asserts, contrary to some others, that the bones in cleft palate are not defective in structure nor incomplete in development, but simply show abnormal elevation of the palate and failure of union, the cause of which is still under dispute.

He uses only lead plates, sutures of silver wire and horsehair in cleft palate operations. Brophy stresses the point that shock in a child under three months is much less severe than after that time. Very little anæsthetic is required in a child two weeks old, as the reviewer can testify from his own experience. Such a child seems insensitive, due to the fact that the central nervous system is yet non-medullated.

Brophy classifies fifteen forms of cleft palate with diagrams of each. The first six forms concern various types of cleft of the soft palate and these may be closed at any time up to the period when the child begins to talk. Forms

seven to fourteen inclusive concern clefts of the hard palate, and they should all be closed by moulding the bones together while they are still soft, preferably before two months. After five months it is impossible to bring the bones together by any technic. The only resource then is to cover the cleft with soft parts. Form fifteen is inoperable because the premaxillary bone is wanting, leaving a large notch in the anterior part of the palate which must so remain. The various operations on all the forms is clearly pictured so that he who reads may easily run. To accomplish these operations much patience and technical skill are required. The difficulty is that the general surgeon will usually not take the time to acquire knowledge of the necessary details, in consequence of which he frequently fails, condemning the method when it is his own shortcoming. Theoretically, Doctor Brophy is undoubtedly correct in his conception of the necessity of the very early moulding of the bones together in order to get perfect speech later on. The time is coming when every child with a cleft palate will be referred to the surgeon immediately after birth, and the surgeon, if he is conscientious, will have to learn the technic as so beautifully worked out by Doctor Brophy. Protruding premaxillary bones should never be removed, but should be displaced backwards so that the raw edges will be brought in contact with the raw edges on the maxillæ, where they will unite with these as would be the case, where they fractured. Among adults, Doctor Brophy considers, as inoperable, a patient in which there is an absence of tissue or one in which there is so little tissue that the construction of a hard palate surgically would be impossible even though we use the pharyngeal muscles, in which case a useful artificial palate should be made. Doctor Brophy has demonstrated without cavil that the beneficial result of the early operation is that it permits the normal development of the bones and consequently the function of speech which is the great desideratum. On page 214, he summarizes, in fourteen paragraphs, the advantages of his early operation. In adults the operation, as Brophy performs it, is not different from that customarily performed. The edges of the lifted-up mucoperiosteal flaps are sutured with horsehair and lead plates are put on the sides and held in place with silver wires as relaxation sutures. Lateral relaxation incisions in the hard palate are used, but for the purpose of relieving tension in the soft palate, no lateral incisions through the tensor palati, or any of the other palatal muscles, should be made as the function of the palate is permanently damaged thereby. On page 249, he gives eight reasons why lateral incision through the soft palate should not be made. When the palatal muscles are too short, Brophy has advised a brilliant procedure to lengthen the palate. He makes an incision (page 254) through two-thirds the width of the palato-pharyngeal muscle and adds this tissue to the end of the palate, thus securing a palate as long as one wishes. This increased length enables the palate to come in contact with the posterior pharyngeal wall. Doctor Brophy, through 1921, has done 5076 cleft palate operations, with 264 deaths, or 5.20 per cent mortality.

The book has valuable chapters on Infant Feeding by Doctor Belknap,

with supplementary suggestions in feeding Cleft Palate children by Doctor Brophy. There is a chapter on the Training of Speech after Cleft Palate Operation by G. Hudson-Makuen, and another on Eugenics, in which Doctor Brophy expresses his belief that heredity is a powerful influence in causing Cleft Lip and Palate, and that "in view of the conclusions reached by students of eugenics, I am satisfied that these defects are endemic." The book closes with an extensive bibliography, covering the time from Celsus to the present.

No surgeon who pretends to do cleft lip and palate operations can afford to be without this epoch-making book. It is a complete treatise on the subject, and no one need look further for a consideration of any phase of the subject. The reviewer can only express his admiration at the clearness of the descriptions of the various procedures, supplemented as they are so fully with 466 illustrations.

CLARENCE A. McWILLIAMS

DISEASES OF THE RECTUM AND COLON AND THEIR SURGICAL TREATMENT

By P. LOCKHART MUMMERY, F.R.C.S., Eng., Senior Surgeon to St Mark's Hospital for Cancer, Fistula, and Other Diseases of the Rectum, etc. New York: William Wood and Company, 1923.

The author clearly states in the preface that this book is not a revision of his former book on diseases of the rectum, because it seemed wiser to combine two volumes into one. This certainly is progressive and altruistic medical book-writing when we observe that throughout his text he has honestly adhered to that viewpoint.

To a reader familiar with books dealing with this specialty in medicine his thoroughness, broad knowledge and, above all, the expression of his frank personal opinions are most edifying and gratifying.

The volume not only presents a thorough and very liberal discussion of the medical and surgical treatment of rectal diseases, but also a most comprehensive treatise on the surgical treatment of the diseases of the entire colon. He thereby makes complete this knowledge, seldom described but necessary, in a text-book on the subject.

One is impressed by the author's familiarity with American medical literature on the diseases of the colon and rectum because of the numerous quotations and references which bear out this fact. This book is eminently serviceable as an international treatise that is broad enough in its views to include a recognition of American ability, which should be taken as a compliment by any reader in this country.

MARTIN L. BODKIN

CORRESPONDENCE

CRIPPLED JOINTS AND FLAT FEET

EDITOR ANNALS OF SURGERY

Sir

The most common orthopædic affections which have come my way have been attributed to "rheumatism," chronic arthritis and flat foot. The essence of the former and the existence of the latter were in ninety per cent of the cases unheeded by the doctors who had been previously in attendance. An anomaly which, as a general surgeon, I can only assign to defective teaching or to ineptitude induced by the latest fizzle—iridized by the term "team work" which unwittingly, in the first instance, eliminates the rudimentary maxim "look and see" and, in some quarters, is soothingly interpreted as "dud" to trouble about any detail examination until the germ finder, blood solver, ray reader and scatologist have given their verdict. Then arrives the psychological moment for clinical acumen and diagnostic wisdom.

I do not know of any advance during recent years in medical science of greater importance to the health of the community than the discovery that diseased teeth (frequently an unsuspected pus bag or latent septic root) are the usual cause of what is nothing more nor less than a form of pyæmic arthritis which gradually produces marked deformity.

During the past two years I have had four cases under treatment who were carried into hospital on a chair and appeared at first sight hopeless cripples—knee joints fixed in extreme flexion by "dry" arthritis. They had been previously under other medical treatment and in each—on admission—the mouth was a cess pit, carious teeth, vile stumps and foul gingivitis.

Within twelve months—after immediate removal of the putrid teeth followed by location in the "continuous outdoor," liberal feeding (with wine or stout), daily massage, and diathermy—these patients walked out of hospital with free movement in knee joints. A result, as viewed from the past, which almost admits of the term—miracle.

In many instances it is quite remarkable what a sudden subjective improvement follows in the general condition of the patient. I frequently hear within a week or so after the infected teeth have been got rid of, "I feel quite different" "I have not felt so well in myself for years," etc.

Rarely a day passes without my having to send some patient to a dentist with request, "If you cannot see anything suggestive of a septic focus, please have an X-ray photo taken." Occasionally I have had to change the dentist and photographer before finding it.

Flat Foot—At a minimum calculation one patient per fortnight consults me for some condition of feet, ascribed by his medical attendant to gout or rheumatism, terms for which on examination I cannot find any meaning except as academic screens for scientific ignorance or for what is more perplexing, sheer laziness.

Invariably I ask such patients when your boot and sock were off, did

your doctor request you to put your foot to the ground? The reply is, "He did not" He failed even to observe the rule of a vet "see a suspect limb in action"

Surely it is not asking too much of a man, even at peril of his being kicked out of "the team," to muster up sufficient energy as to beg of every patient who happens to consult him about a foot in which there is no obvious lesion, to remove the other boot and sock and take a few paces over the carpet

By doing so I feel certain that patients would hear much more about correction of strain, the necessity for a pair of suitable boots and special exercises and a great deal less of what may be truly described as a disgrace to the term *Medicine*

With all respect to that exalted mentality which takes pride in exclaiming so that all may hear "oh, I am sure I know nothing about that first take him to the physician" or "to the nerve man" I have in diagnostic quest, for many years, made it a practice to strip the patient scan him anteriorly, posteriorly and laterally from the crown of his head to the soles of his feet and give a special glance, feel, ear or tap to the things I pass on the way

Regardless of what people may think or say, I maintain (and shall continue doing so) that if the practice of medicine and surgery is to continue ranking as a profession, thorough clinical (detail) examination must always be made and diagnostic probability focussed by the physician or surgeon primarily in charge of the case before seeking what then becomes the inestimable aid of the experts previously mentioned, without whose assistance our work to-day would be an anachronism

JOHN O'CONOR, M D,
Buenos Aires, Argentina

THE TOXINS OF PREGNANCY AND GALL-BLADDER DISEASE IN THE FŒTUS

EDITOR, ANNALS OF SURGERY

Sir

I was much interested in Doctor Kellogg's article on "Gall-bladder Disease in Childhood" (ANNALS OF SURGERY, May 1923) There is in this his usual carefully guarded statements which are much admired The significance of his summary is to me important

The statement that "cholelithiasis in the newborn appears to be due to an unknown foetal pathology and is usually fatal," is quite in line with my studies, and the author's statement that in acute "infections" of the gall-bladder "no other infection could be found" shows the dilemma in which the clinicians find themselves The same factors that produce cholelithiasis and cholecystitis in the foetus are found to be at work in the adult In our researches on the toxins of pregnancy from tissue breakdown it was found that no other toxin produced the pathological changes in the mother or offspring This toxin is the cell substance itself freed by disintegration from the cell and is therefore appropriately termed cytost In these researches we have made (over 1000 animals) on mother and off-spring with cytost

reaction, all varieties of cholecystitis were shown—with and without stones. This pathology of the bile channels is only incidental to other changes produced by tissue toxin cyto-st. The early acute reaction found in the liver beginning in the bile ducts in the portal zone was observed by me as early as 1903 when experimenting with what I then termed "shock toxin," now known as cyto-st. The repeated observations on these fundamental biological changes which I have reported in over 100 publications, ought to make it easy to trace the clinical findings and the origin of these changes in the liver. This is especially so, since Limousin of Pasteur Institute, Prof. Henri Hartmann and Professor Jeanneney (of the Université de Bordeaux) have verified this work. It seems incredible that the clinical mind must remain contented with a statistical and symptomatic explanation when well-known biological principles are so well established. Unless it can be agreed that fundamental knowledge is only acquired by experimental research, no further discussion is profitable. Empiricism and pure assumption for the explanation of biological phenomena is no longer tenable.

The "unknown foetal pathology" which the author refers to has been the subject of much research by biologists on the egg cell and embryo. In this all the reactions were found to be due to the action of the cell substance itself on the living cells. In low concentration cyto-st acts as a cell stimulant, excites cell division, growth and increased metabolism. In high concentration of cyto-st the opposite condition is produced—morbidity and death.

This is quite in line with empirical experience. That which stimulates in low concentration causes disintegration in high concentration. It is not difficult to follow as the embryo develops into a foetus the same law continues. Be that as it may, the twenty-five years of research which I have conducted on the principle of cyto-st reaction and their results which have been reported in over 100 publications, has received full verification by biologists working in similar lines. As concrete evidence I might refer you to Limousin's recent report of this work (*Journ. Medicale Francais*, June, 1923, pp. 238-40). This brochure contains full laboratory verification, also clinical observations which he had delegated to others at the Pasteur Institute. The French are among the most able critics in science, as well as art, and if authority is all that is needed, it will be found here.

Doctor Kellogg's excellent report should stimulate the most rigid investigation of the biological reactions which occur in the pregnant state, and note that similar reactions occur in the non-pregnant state.

FENTON B. TURCK, M.D.,
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All contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 145 Gates Ave., Brooklyn, N. Y.

Remittances for Subscriptions and Advertising and all business communication should be addressed to the

ANNALS of SURGERY

227-231 S. 6th Street
Philadelphia, Penna.

ANNALS of SURGERY

VOL LXXIX

FEBRUARY, 1924

No 2

THE TREATMENT OF PARALYSIS OF THE RECURRENT LARYNGEAL NERVE BY NERVE ANASTOMOSIS*

By CHARLES H. FRAZIER, M.D.
OF PHILADELPHIA, PA

Preface Dr Chevalier Jackson and the writer in January, 1923 discussed the possibility of relieving that most distressing condition bilateral paralysis of the recurrent laryngeal nerve by a method comparable in principle to that employed so successfully in paralysis of the facial nerve. The initiative for this discussion must be accredited to Doctor Jackson to whom has been referred for advice and treatment a number of patients from various parts of the country, with bilateral paralysis of the recurrent laryngeal nerve following thyroidectomies.

The possibility of accidental trauma to this nerve in operations upon the thyroid gland has always been appreciated, and surgeons, in the elaboration of their technic, have endeavored to devise methods whereby the recurrent laryngeal nerve would be protected from injury. That the accident may occur in the hands of the most experienced and skilled operator has been demonstrated by the material at hand. It is not necessary for the purpose of this discussion to review the various articles dealing with this complication of thyroidectomy, suffice it to say it is not unreasonable to assume that in the majority of instances the nerve is injured either at the inferior pole of the lateral lobe or at its passage to the inner side of the lateral lobe as it courses upwards in the groove between the trachea and œsophagus. At all events if the nerve has been resected throughout its entire course, the conditions essential for the operation to be proposed are lacking. That this may happen was illustrated in one of our cases.

Z. G. File No. 863 N. S. Diagnosis Unilateral Paralysis of the Recurrent Laryngeal Nerve. Patient was operated upon in another hospital, March, 1917, at which time all of the right lobe and possibly some of the left lobe were removed. She was referred to my clinic at the University Hospital by Dr. Henry K. Pancoast with an enlargement of the left lobe of the thyroid gland and a paralysis of the right recurrent laryngeal nerve. Operation was undertaken for the relief of the paralysis but it was impossible to find any remnant of the recurrent laryngeal nerve. Apparently it had been removed throughout its course when the right lobe had been resected at the previous operation.

Clinical Considerations Complete bilateral paralysis of the recurrent

* Read before the Philadelphia Academy of Surgery, October 1, 1923.

NOTE Up to the time of publication three patients have been operated upon and while sufficient time has not elapsed to make a final report in two of them there is evidence of returning function. The record of only one of these cases is included in this contribution.

implies paralysis of the intrinsic muscles of the larynx, the constrictors, dilators and the intrinsic tensor. While this in turn rarely implies aphonia, more or less impairment of phonation usually is present, due to the paralysis of the lateral crico-arytenoid muscles and the thyroarytenoideus. It is attended

also with dyspnoea more or less acute, according to whether the paralysis of the posterior crico-arytenoid muscles is complete and bilateral. If both sides are paralyzed but not yet cadaveric, the respiratory distress is such that a tracheotomy becomes a matter of urgent necessity rather than choice.

Doctor Jackson reminds me that a monolateral or bilateral paralysis of the recurrent laryngeal nerve may be present in a patient with an excellent voice—a fact which the general surgeon may not appreciate. Many surgeons have erroneously taken themselves to task for causing a paralysis, which as a matter of fact may have existed before the thyroidectomy. The erroneous inference was drawn because the patient before the operation had a perfect voice. In the goitre clinic at the University Hospital, every patient is sent to Doctor Jackson's Clinic before the operation for a report on the functional activity of the vocal cords, as a matter of protection and satisfaction to the surgeon the pre-operative condition of the vocal cords should be made a matter of record. It is often not until the lost tonus results in a cadaveric glottis that the husky "stage whisper" aphonic stage is reached. In fact, according to Jackson this stage may never be reached. In one case under his observation it has not yet occurred at the end of twenty-two years.

The terms "complete" or "total" paralysis should be used only in the condition of the larynx in which not only are the abductors, tensors and adductors paralyzed but the reflex tonus gone (See Fig 1). In this total paralysis the glottic chink is wider and dyspnoea lessened, there is much air waste and the voice is very husky. Pulmonary complications may develop from absence of glottic cooperation in the heclic cycle and

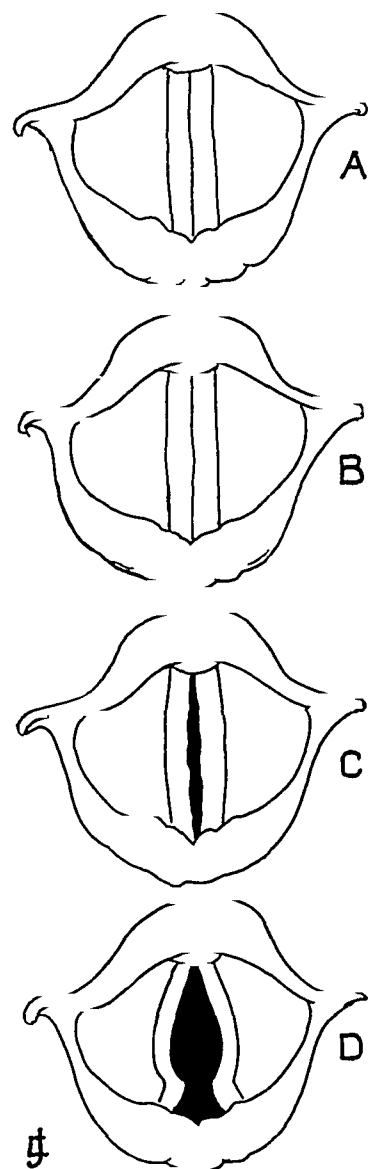


FIG 1—Schematic illustration of the stages of organic bilateral paralysis. A normal phonation. B phonation bilateral posticus paralysis. C phonation, paralysis has reached the tensors (thyroarytenoidei). D final complete stage posticus thyroarytenoidei laterales all affected. In this last stage which may never be reached the voice is husky and there is air waste.

the patient may even "drown in his own secretions."

In cases of subtotal paralysis, posticus paralysis of one vocal cord and partial posticus paralysis of the other, the possibility of impending suffocation should the partial paralysis of the functioning cord become complete, is such

that a tracheotomy should be performed as a precautionary measure. As an illustration of this, I may cite this case.

J. C. File No. 844 N. S. The patient was referred to me because of a recurrent laryngeal paralysis. She had a thyroidectomy performed elsewhere on June 19, 1922. Her voice has never been normal since but is growing stronger although her breathing has been growing more difficult. February, 1923, a laryngeal examination in the clinic of Dr. Chevalier Jackson showed one arytenoid cartilage entirely immobile, the other partially so. The left cord showed a lack of tension. February 13, 1923, a tracheotomy was performed. February 17, 1923, an examination of the lungs with tracheotomy tube open revealed certain changes from the signs found prior to tracheotomy. April 27, 1923, laryngoscopic examination showed that the patient needed only about two millimeters more abduction of her right cord to have a fairly satisfactory glottic chink.

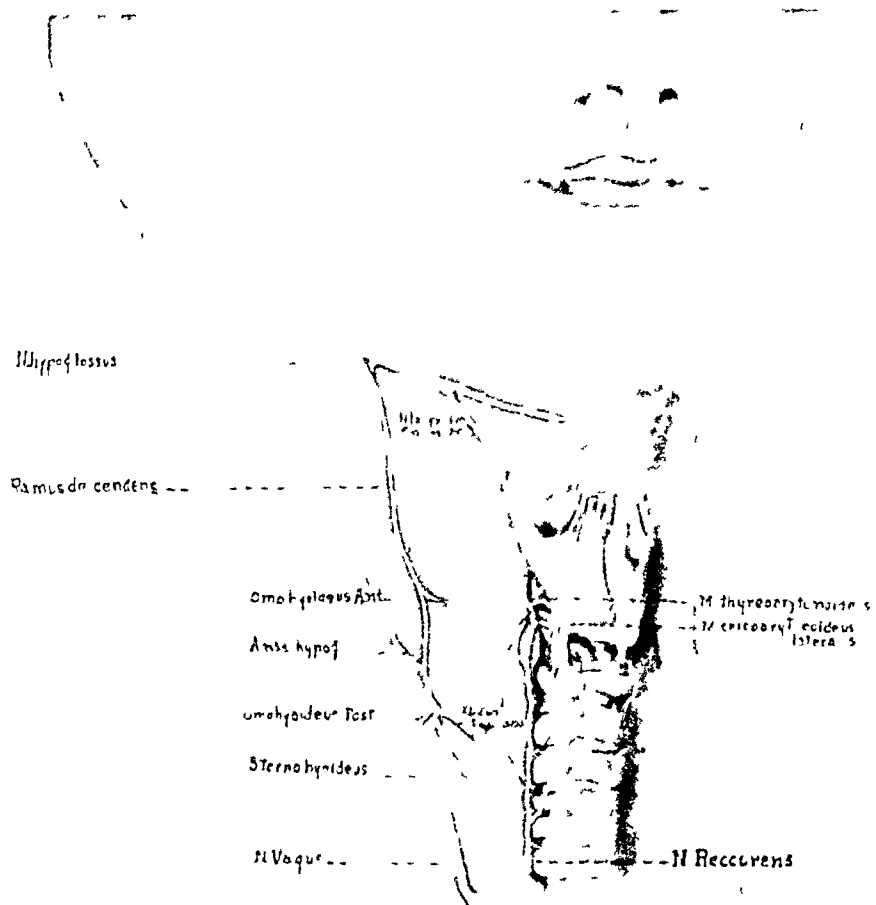


FIG. 2.—Showing the course of the recurrent laryngeal nerve and the ramus descendens hypoglossi. The inferior constrictor of the pharynx has been removed to expose the muscular branches of the recurrent laryngeal.

With a tracheotomy tube in place the danger of suffocation is, of course, averted. But the establishment of a tracheal fistula is merely an emergency measure and were there no promise of relief, no means of dealing directly with the essential lesion the situation is tragic. In the past, Doctor Jackson has resorted to several methods, whereby the tracheal tube may eventually be dispensed with: (1) by dilatation of the glottis with bougies, resulting in outward displacement of the arytenoid cartilages, (2) by ventriculocordectomy removing all of one vocal cord and the adjacent ventricular floor anterior to the vocal process. This ingenious method admits on inspiration an adequate supply of air, thus dispensing with the tracheotomy tube, but it does not restore the flexibility of phonation and the patient for a long time is unable

to talk except in a whisper. Eventually a fairly loud, though rough, phonation of deep pitch is obtained, but the method is crude compared to restoration of innervation without endolaryngeal operation. The shortcomings of this palliative endolaryngeal operation prompted Doctor Jackson to consider other methods of relief and at this juncture our conjoined efforts began.

Contra-indications It is necessary to be certain that there is free motility of the crico-arytenoid joint. In case of fixation of this joint, it would be hope-

less to expect any motility to be restored no matter how perfectly an anastomosis might restore innervation. The best method of determining the degree of motility of the crico-arytenoid joint is by making passive motion with a laryngeal forceps used through the direct laryngoscope.

Physiological Considerations—Given a case of nerve interruption from trauma, one's first inclination is an attempt at restoration of continuity by direct end-to-end suture. This principle has long been applied, of course, to injuries to peripheral nerves and that, it may be



FIG 3—The recurrent laryngeal nerve and its terminal branches drawn to a larger scale showing its terminal branches and its relation to the inferior corner of the thyroid cartilage

applied to the *n. recurrens* has been demonstrated. We take it for granted, therefore, that in any operative undertaking for paralysis of this nerve the operator first investigates the possibility of repair by end-to-end suture. Assuming, as I believe will be the case in some instances, that this operation is not feasible, because the nerve lesion is too extensive, what other operative procedure is applicable? Nerve anastomosis is the first to come to mind. For this purpose a nerve predominantly motor in function is desirable. In

ANASTOMOSIS OF RECURRENT LARYNGEAL NERVE

the operative treatment of facial paralysis the n hypoglossus and n accessorius have been chosen For the n recurrens I at once chose the i descendens hypoglossi

It would seem that the i descendens hypoglossi both from anatomical



FIG 1 —Showing relationship of recurrent laryngeal nerve to the inferior constrictor of the pharynx and the inferior corner of the thyroid cartilage

and physiological considerations for our purpose would be ideal Situated not too far from the n recurrens readily exposed on the sheath of the carotid vessels and of sufficient length to make possible its transposition to the peripheral stump of the injured nerve the r hypoglossi descendens in its anatomic relations offers all that one could ask for

While we know little or nothing of the physiologic process whereby the

cortical centre for a given movement accomplishes its purpose through a new peripheral connection, as when the n hypoglossus is implanted into the n facialis, the fact remains that by this process the cortex finds a way to act and voluntary motion is restored. One has but to recall the patient's ability to close the eye or whistle after a hypoglosso-facial anastomosis. Without any knowledge of the physiological *modus operandi*, whereby the cerebral cortex assumes this new function, writers on this subject frequently refer to the process as one of reeducation. But whatever may be the nature of the process, it would seem reasonable to assume that the more alike the old and

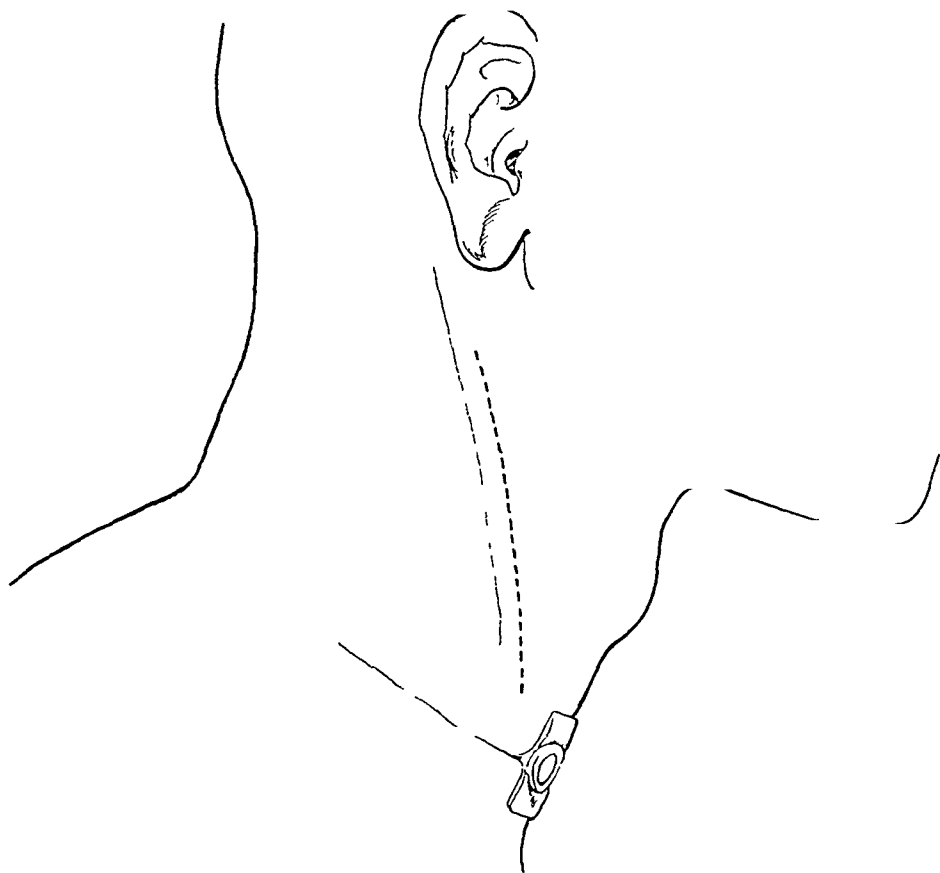


FIG 5 —Relation of incision to tracheotomy tube

the new, the normal and the assumed function of a given cortical centre, the greater the likelihood of its performing its newly assigned duties. Or, to put this thought in other words, the nearer the cortical centres presiding over the movements under consideration, the greater the possibility of one centre assuming the function of another. It is true, is it not, that the functions of the muscles supplied by the n recurrens and the r descendens hypoglossi are alike in this respect, namely that the muscles they supply, that is both the intrinsic and extrinsic muscles of the larynx are physiologically a part of the same apparatus. If, therefore, this be true, viewed from the physiological angle, the r descendens hypoglossi would be the nerve of choice. Not only should it be chosen on anatomical and physiological grounds, but because the residual paralysis of the sternohyoid and sternothyroid muscles, which the

ANASTOMOSIS OF RECURRENT LARYNGEAL NERVE

n descendens hypoglossi supplies, is a matter of no very great consequence either from the cosmetic or functional standpoint. In this respect there is a striking difference between the n descendens hypoglossi and the n accessorius or n hypoglossus, either of which one may use for facial paralysis. If the n accessorius is employed, the resulting paralysis of the trapezius and sternocleidomastoid is not without its discomforts and disability, if the n hypoglossus, the resulting hemiatrophy of the tongue, while not interfering either with speech or deglutition, sometimes disturbs the patient's vanity. As a

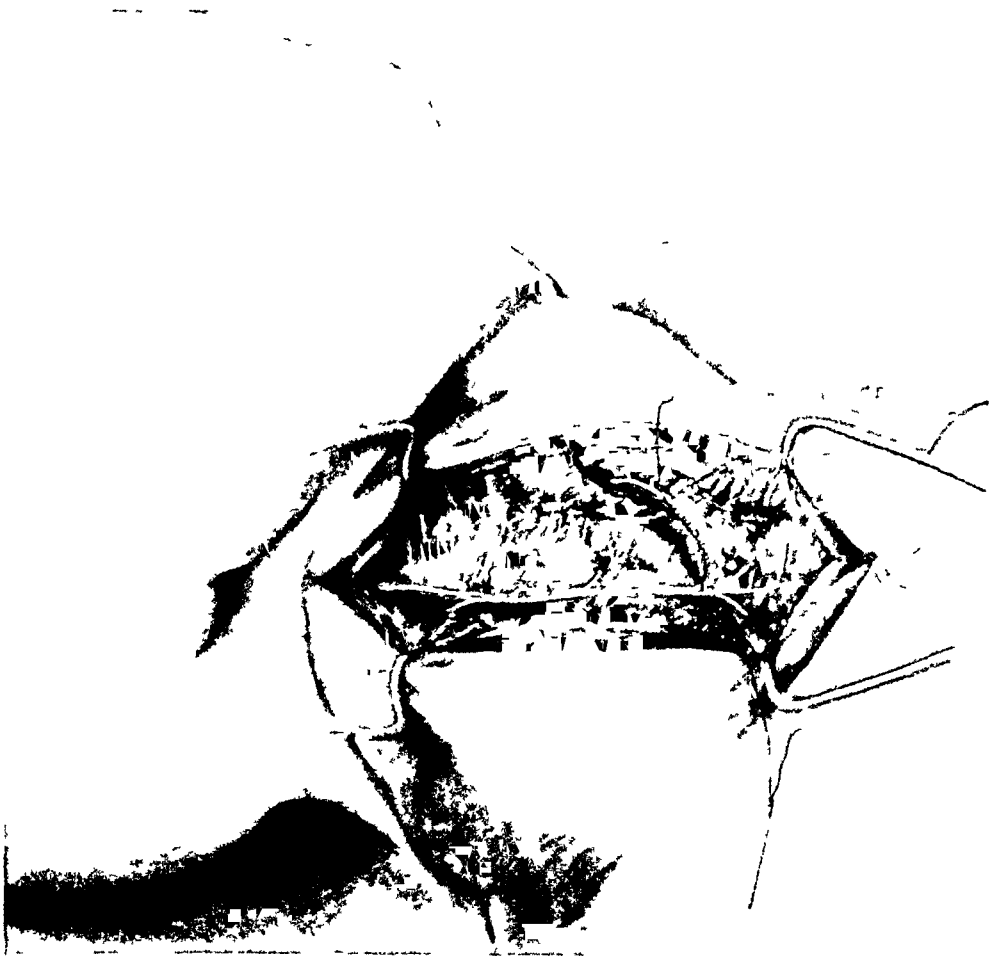


FIG. 6—A single suture introduced in both nerves before section of either

matter of fact hemiatrophy of the tongue may be prevented by suturing the n descendens hypoglossi to the peripheral stump of n hypoglossus.

While the return of voluntary motion is an accepted fact, after a faciohypoglossal anastomosis, can the same be said of involuntary or subconscious movements? I have yet to see the case in which the complicated involuntary or expressional movements are restored after a faciohypoglossal anastomosis. This *a priori* would seem a matter of very practical moment when considering a method of restoring function to the vocal cords. We enter at once into the realm of function other than voluntary. Looking for a muscle movement analogous to that of the vocal cord movement as in the act of inspiration, we find one not unlike it in the action of the constrictor muscles of the pharynx, but there is no instance of paralysis of these muscles which so far as I know

function has been restored by any surgical procedure, that is by any transfer of nerve impulse from one nerve to another, as in the customary fascio-hypoglossal anastomosis. Whether the involuntary act of winking might come within the category of movements under discussion, is an open question. This movement, of course, is governed by muscles supplied by the facial nerve but, curiously enough, I have no record of an observation or an inquiry into the return of this movement after a successful suture of the hypoglossal

to the facial nerve. I find, however, an observation by Kennedy (Philosophical Transactions of the Royal Society of London, Series B, vol cxi, pp 93-163) who in a case of facial spasm, sutured the spinal accessory to the facial nerve and 470 days after the operation Kennedy noted that "winking as a reflex movement was

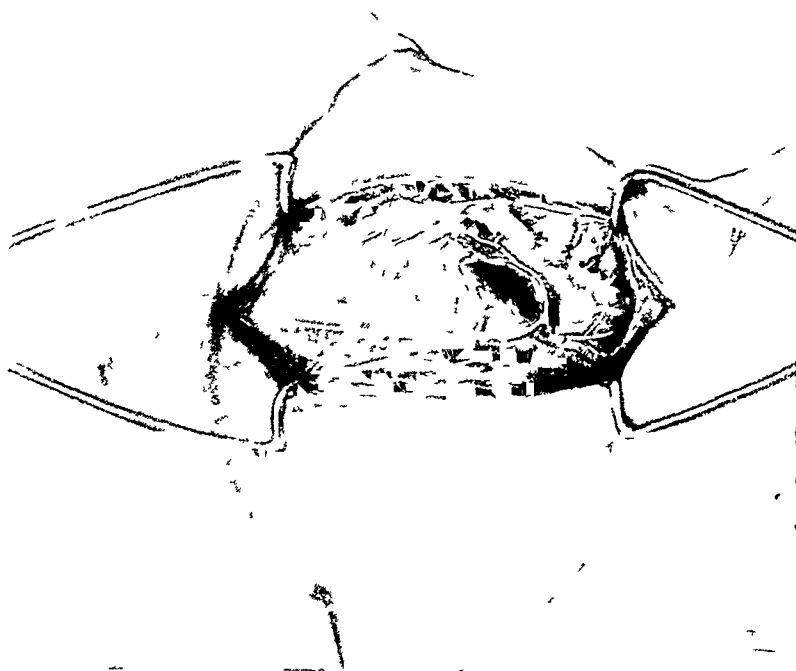


FIG 7—The central segment of the r descendens hypoglossi united by a single suture to the peripheral segment of the r hypoglossi

quite efficient." This is a very significant and quite pertinent observation.

Whether function would be restored to muscles engaged in an involuntary or subconscious movement would depend chiefly upon whether the movement was initiated by a peripheral or central stimulus. In this particular movement, *i e*, contraction of the dilators in respiration, the stimulus is peripheral, and since the peripheral mechanism has in no wise been disturbed, it is not unreasonable, accepting our premise, at least to admit of the possibility of a return of this involuntary movement after a properly executed nerve anastomosis. The proof of the pudding, however, is in the eating, and we must wait developments in the cases already operated upon.

Technical Considerations After these rather theoretical considerations,

let us turn to the steps of the operation itself. We contemplate an end-to-end suture between the *r. descendens hypoglossi* and the peripheral segment of the *n. recurrens*. A brief reference at this point to the regional anatomy is pertinent. One can visualize the course of the recurrent laryngeal nerve in its normal relationships (see Figs. 2 and 3) and I call attention to the relationships of the nerve above the superior pole of the thyroid gland especially to the lower border of the inferior constrictor of the pharynx behind which the nerve passes before its bifurcation. We must assume that as a rule from

the superior pole of the lateral lobe down, the *n. recurrens* will be entangled in cicatricial tissue, resulting from the previously performed thyroidectomy, from which it would be difficult, if not impossible, to disengage it. It is essential, therefore, that some anatomical guide be selected, which will direct one to the nerve above the level of the lateral



FIG. 5.—Photograph of patient showing scar of incision along anterior border of the sternocleidomastoid muscle.

lobe or the stump of it. My studies in the anatomical laboratory in material kindly placed at my disposal by Dr. John C. Heisler led me to choose the interior cornu of the thyroid cartilage (Fig. 4) as the most constant and readily localized anatomical guide. This process and the inferior constrictor of the pharynx which is attached to the interior cornu and the adjacent surface of the thyroid cartilage are the important anatomical landmarks and one may see the *n. recurrens* dividing at this level into two branches, one to supply the inferior constrictor and one to the intrinsic muscles of the larynx.

Once the peripheral portion of the nerve has been uncovered and identified, the remainder of the operation is plain sailing. Even with the directions as given for finding the peripheral segment of the nerve, the task is not an easy one and a number of dissections should be made in the anatomical laboratory before attempting the operation in the clinic.

Steps of the Operation—1 Anæsthesia It must be recalled that there is *in situ* a tracheotomy tube which cannot even temporarily be removed. The administration of the anæsthetic through the tracheal tube is not practicable for obvious reasons. Hence, the operation must be performed under local anæsthesia (Novocain-adrenalin).

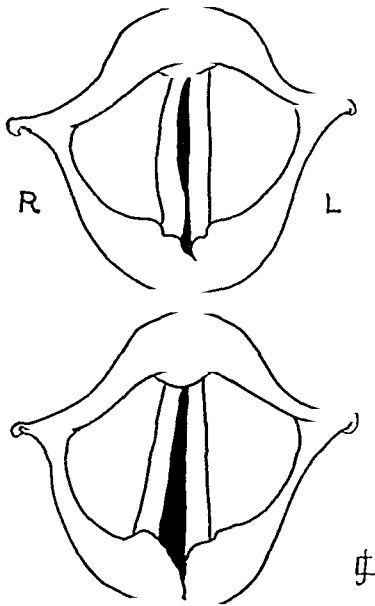


FIG 9—Schematic illustration of the shape of the glottis and position of the cords before and after anastomosis of the right *n. recurrens* with the right *n. descendens* showing improvement in tension, tonus and glottic lumen. Mirror view. Case of bilateral recurrent paralysis complicating cervical goitre. The upper illustration shows the condition before operation. The right cord (R) is cadaveric.

2 Incision It is to be recalled, also, that there is the scar of the collar incision from the original thyroidectomy plus the tracheal fistula. To minimize the incidence of wound contamination from tracheal fistula, the incision should be as far away from the median line as is consistent. To meet all the requirements an oblique incision is made along the anterior border of the sternocleidomastoid muscle (Fig 5).

*3 Identification of peripheral segment of the *n. recurrens** This dissection is carried out according to the instructions already given (See technical considerations).

4 Identification of the ramus descendens hypoglossi The nerve is readily identified as it descends on the anterior surface of the sheath of the carotid vessels.

5 Introduction of single epineural suture of arterial silk in both nerves while in continuity, that is before either is bisected. The point at which the suture should be introduced in the ramus descendens hypoglossi should be determined by careful measurements. A point should be selected, which after transposition will enable the suture to be tied without any

tension whatsoever and preferably above the point at which are given off branches to the omohyoid, sternohyoid and sternothyroid muscles (Fig 6).

6 Bisection of nerves and tying sutures (Fig 7).

7 Wound closure There is a potential source of infection from the tracheal fistula which must never be lost sight of throughout the operation. After the incision is made, wound draperies should be used to protect both the margins and the deeper planes of the wound. Unnecessary wound trauma must be avoided by clear, sharp dissection and before wound closure hæmostasis should be *absolute*. The wound itself is closed with tier sutures, the cutaneous margins with Michel clamps.

8 After-care The toilet of the tracheal fistula should be entrusted to a special attendant. Small gauze pads should be applied beneath the flange of the tracheal tube and changed as often as they become soiled. A strip of gauze half an inch wide is sufficient to protect the operative wound. The smaller the dressing, the less likely contamination by continuity from the tracheal fistula.

*Report of Case—*M. H., File No 1570 N. S. referred to the Neurosurgical

ANASTOMOSIS OF RECURRENT LARYNGEAL NERVE

Service at the University Hospital, by Dr Chevalier Jackson and Dr John C Heisler

In another clinic a thyroidectomy had been performed in 1917. Following this the patient complained of shortness of breath and difficulty in breathing. The dyspnoea became more distressing and in December, 1922, a tracheotomy was performed by Dr Gabriel Tucker. A laryngeal examination at that time showed almost complete bilateral paralysis of the vocal cords. In June, 1923, Doctor Jackson referred the patient to the Neurosurgical Clinic for an anastomosis of the r descendens hypoglossi to the n recurrens.

Operation June 29, 1923. End-to-end suture of the peripheral section of the recurrent laryngeal nerve to the descendens hypoglossi. The operation was performed under local anaesthesia. Through an oblique incision following the anterior border of the right sternocleidomastoid muscle the region was exposed and the stump of the recurrent laryngeal found from 2 to 3 cm below the lower margin of the thyroid cartilage. Evidently it had been severed at the previous operation just above the isthmus. The descendens hypoglossi was readily found and divided at the proper level and the two segments united with a single arterial silk suture. The wound healed by first intention.

In two weeks the patient was discharged from the hospital with instructions to report to Doctor Jackson for observation.

September 20, 1923. Doctor Jackson examined the patient and wrote me as follows: "Mirror examination shows the glottic chink on deep inspiration to be about twice as wide as before operation. There is more movement in the cord and while the excursion is only slightly greater, it is, I think, sufficient to be unmistakable."

Encouraged by the positive evidence of returning function fifty-two days after operation, the patient returned to the Clinic at the University Hospital for a nerve suture on the left side November 7, 1923.

Operation November 13, 1923. Proceeding under local anaesthesia, an incision was made, as at the first operation, along the edge of the sternocleidomastoid muscle. What remained of the recurrent laryngeal nerve was found just at its point of bifurcation into terminal branches beneath the inferior constrictor of the pharynx. For adequate exposure it was necessary to divide this muscle. The r descendens hypoglossi was then isolated and divided at a point sufficiently far down to admit of its apposition to the recurrens without tension. Apposition was effected with two epineural arterial silk sutures. Wound closure without drainage (Fig 8).

November 26, 1923. Doctor Jackson submitted this report: "A very encouraging feature of the improvement is the restoration of tonus and tension. The right thyroarytenoideus, which was apparently motionless before the operation, is now quite active. With restoration of tension and tonus, the crescentic form of the cordal edge has been replaced by a normal margin. The patient notices a decided improvement, subjective^{ly}, in the laryngeal air-way." (Fig 9).

It is too soon of course to expect any restoration of function in the left side, but the continued signs of returning function as recorded in Doctor Jackson's several reports, gives promise of an eventual recovery.

BENIGN TUMORS OF THE BREAST ENCAPSULATED ADENOMA

A BRIEF SUMMARY OF THEIR CLINICAL AND PATHOLOGICAL FEATURES

By JOSEPH COLT BLOODGOOD, M D

OF BALTIMORE, MD

SYNOPSIS—The more common tumors of the breast Multiple tumors Multiple encapsulated adenoma Single encapsulated adenoma Single encapsulated adenoma clinically malignant Palpation of encapsulated adenoma Palpation of larger encapsulated adenomas Aberrant adenoma Sarcoma in intracanalicular myxoma Differential diagnosis between small encapsulated adenoma and sarcoma Encapsulated adenoma microscopically suspicious of cancer Ultimate results in patients operated on for encapsulated adenoma, without the removal of the breast Adenoma in pregnancy and lactation Operations upon the breast during pregnancy and lactation Exploratory incision and excision of benign tumors of the breast First method of exploratory incision Second method of exploratory incision Third method of exploratory incision Plastic closure Conclusions

The more common tumors of the breast are the *encapsulated adenoma*, some types of *chronic cystic mastitis* (the most frequent of which is the blue-domed cyst), and fully developed carcinoma The *scirrhous* carcinoma largely leads the soft *medullary* carcinoma

Other lesions of the breast, both benign and malignant, are relatively infrequent

In teaching students, both before and after graduation, and in reviewing one's own experience for the purpose of improving methods for the recognition of the benign from the malignant, both clinically (based on history and palpation) and pathologically (based on the gross and microscopic appearance at the exploratory incision), one should bear in mind the common occurrence of these three great groups and first master them

Multiple Tumors (Figs 1 and 2) I employ the designation A to mean a single tumor in one breast, B a single tumor in both breasts, C multiple tumors in one breast, D multiple tumors in both breasts

When the letter E is placed after A, B, C, or D, it indicates that the single, or the multiple, tumors are indefinite

Multiple definite tumors in the groups, B, C, and D, are rarely malignant, and if so in my experience, always incurable I have recently checked this most carefully Therefore, if one can palpate a definite tumor in each breast, or multiple definite tumors in one or both breasts, a mistake in diagnosing *benign* will never do any harm To completely excise one or both breasts, or even to perform the complete operation for cancer on both sides, would be an unnecessary mutilating operation and should not be done without exploring one of the tumors in each breast and ascertaining their pathological nature

Personally I have never observed a definite single tumor in each breast

BENIGN TUMORS OF THE BREAST



FIG 1—Pathol No 9627 Multiple adenoma removed from one breast, all encapsulated the larger tumor is of the fibroadenoma type the smaller represents an example of each type fibroadenoma, intracanalicular and cystic adenoma From original painting



FIG 2—Pathol No 9627 On 1 case on unilateral photograph of the breast of a patient. On palpation one large and one small movable tumor in the upper outer quadrant. The tumor is small movable, cystic, and benign. Operation removed the tumor and the patient is well. Residual tumor is not present.

or definite multiple tumors in one or both breasts to be malignant, unless there was definite clinical evidence of malignancy

The more common multiple tumors are the encapsulated adenoma and the blue-domed cyst, and for such lesions, complete removal of the breast is not necessary. The larger, or the growing, or the painful tumors may be removed. My records show that too many breasts have been sacrificed for multiple tumors in one or both breasts. These women run no more risk of cancer, and perhaps less risk, than women in whose breasts no lumps can be palpated.

Multiple Encapsulated Adenoma (Fig 3) There are three types of adenoma of the breast—*fibroadenoma* [82 cases] (sometimes called *periductal adenoma*), *intra canalicular myxoadenoma* [198 cases], and cystic adenoma

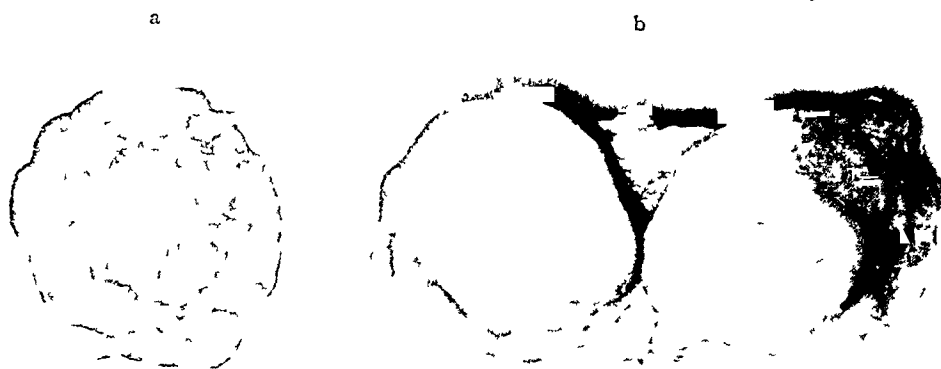


FIG 3—a and b Pathol No 21193 Typical encapsulated adenoma projecting like a dome above the surrounding breast—the appearance one gets at the exploratory incision. The dome is gray, not blue. For appearance of bissection see Fig 3 b Pathol No 21193. The tumor in Fig 3-a bisected. Note the distinct capsule and the zone of breast removed with the tumor. The tumor is of the fibroadenoma type and resembles somewhat normal breast at puberty. It has less stroma and more parenchyma. See Fig 4 for microscopic picture.

(22 cases) The first two varieties are far more frequent than the cystic adenoma. One will observe about 22 cystic adenomas to 280 of the other two types. The cystic adenoma is rarely multiple, the other two varieties are quite frequently multiple.

Multiple adenomas have been observed at any age, but are distinctly more common at puberty and before twenty-five years of age.

In the majority of cases the multiple tumors belong to one type, but not infrequently two, or even three, types may be present. There is no objection to the removal of the larger, the growing or the extremely painful tumor. It is never necessary to remove the breast or the breasts, and in many cases in which all the tumors have not been removed, their disappearance has been noted.

Single Encapsulated Adenoma When palpation finds but one definite tumor, and the patient is over twenty-five years of age, cancer must always be considered. A small encapsulated adenoma buried in breast tissue or situated in a large fatty breast may palpate like a small infiltrating scirrhus.

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Then, again, circumscribed carcinoma, especially when buried in breast or of deep position in a fatty breast, cannot be distinguished from an encapsulated adenoma. The earlier a patient seeks advice after first feeling tumor the more frequently one palpates benign tumors suggesting malignancy and malignant tumors suggesting benignancy. Therefore, every surgeon should be on his guard. The most important points are *first*, never consent to any delay, *second*, always to operate in a hospital and prepare patient for the complete operation for cancer, *third*, whether you excise the tumor, or excise it for diagnosis, always be prepared for the immediate chemical or thermal cauterization of the wound. I prefer pure carbolic acid and alcohol and a fifty per cent solution of zinc chloride to the cautery.

Less than one week ago an experienced surgeon, one of my own students, a teacher of surgery and surgical pathology in a medical school, was so certain that the palpable single tumor was benign that he allowed the patient to persuade him to remove it

under local anæsthesia in his office. After its removal and gross bisected he was horrified to find that it suggested malignancy, but he was not in position to proceed with the complete operation. Fortunately microscopic study demonstrated the tumor to be a *non-encapsulated benign adenoma* not a carcinoma.

In my own clinic I have the greatest difficulty in getting older and experienced internes to remember to prepare for immediate chemical cauterization when a breast tumor is explored for diagnosis.

As a matter of fact, every single tumor of the breast in a woman twenty-five years of age, in which the operator concludes that it is not

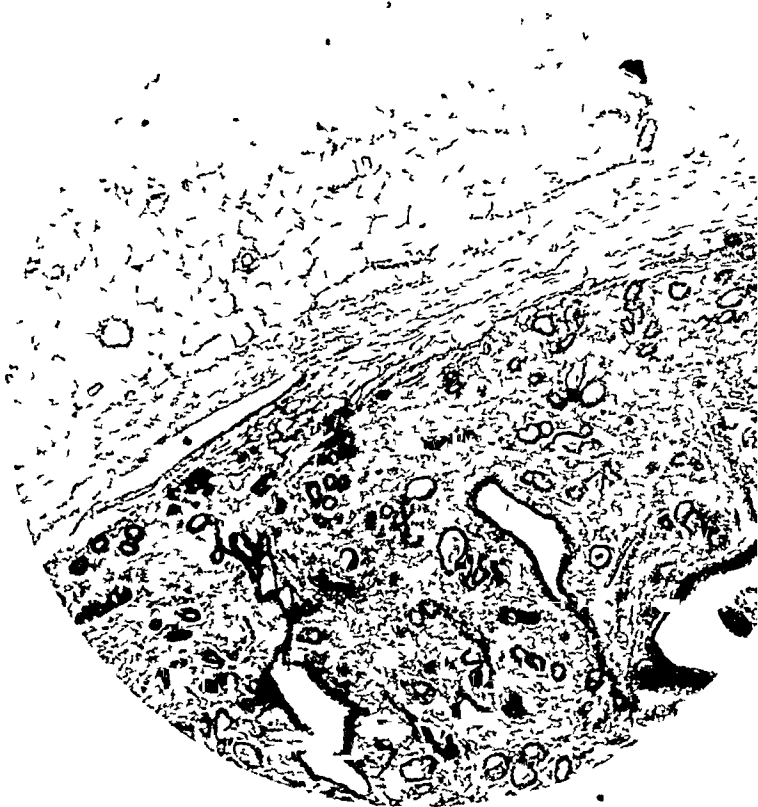


FIG 4—Pathol No 21193 Microscopic section (low power) of adenoma shown in Fig 3. The breast beyond the capsule is very fatty parenchyma in the tumor has no normal lobules with developed acini.

character to justify the complete operation without exploration, must be looked upon as potential cancer and be explored

Single Encapsulated Adenoma, Clinically Malignant (Fig 5) My records show that encapsulated adenomas of all types are so rarely associated with retraction and fixation of the nipple, with atrophy of the subcutaneous fat, dimpling and fixation of the skin, that if the complete operation were per-

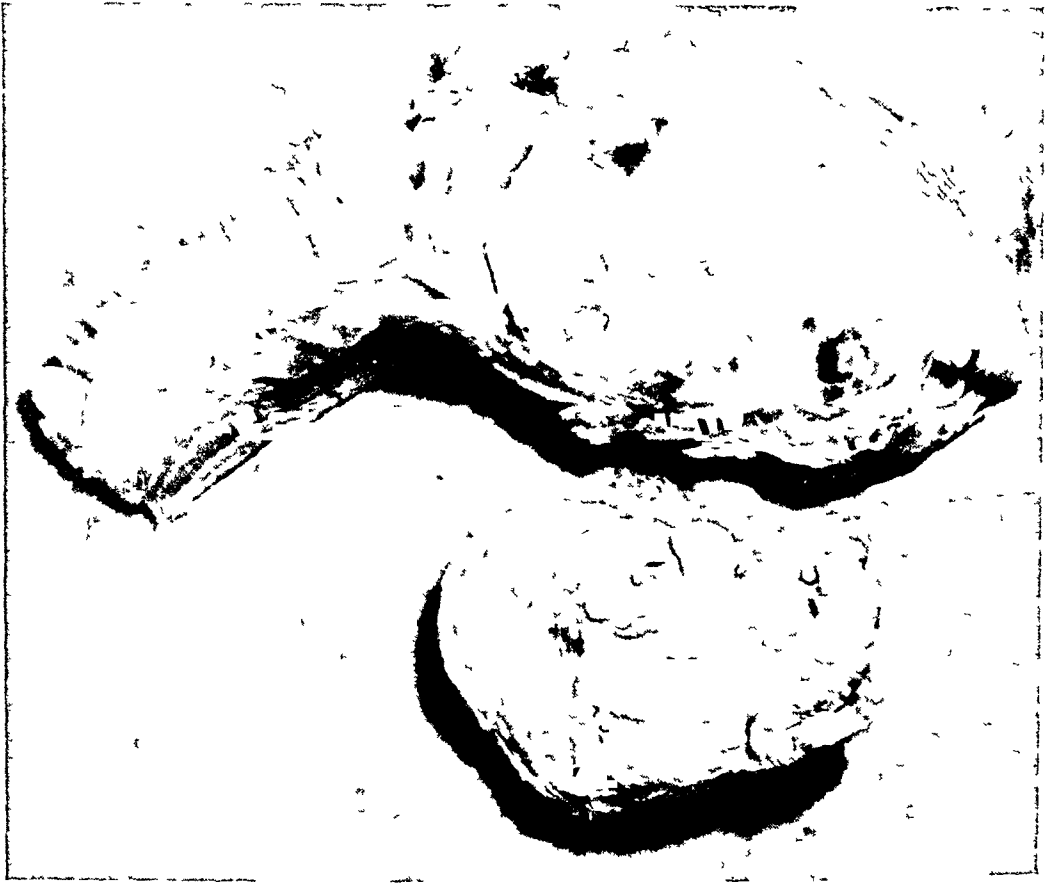


FIG 5—Pathol No 15983 Section through encapsulated adenoma (clinically malignant) and the surrounding breast This patient an adult woman at the menopause had a known movable tumor of many years duration After a trauma it grew from the size of a twenty-five-cent piece to that of a fifty-cent piece There was atrophy of the subcutaneous fat and slight fixation of the skin The complete operation for cancer was performed Exploring the tumor after operation demonstrated oedema outside the capsule Microscopic section of the tumor (Fig 6) shows no evidence of carcinoma or sarcoma The glands show no metastasis and the patient is well more than five years since operation

formed in all such cases, very few women would be mutilated Nevertheless these clinical signs of malignancy now and then do occur with encapsulated adenoma It has been my rule, that when the tumor has the palpation of an encapsulated adenoma or a cyst, and the free mobility of a benign tumor, I am apt to explore the tumor, even when there is a suggestion of dimpling of the skin or atrophy of the fat or slight fixation or retraction of the nipple *This is especially true if the little tumor is in the nipple zone*

More frequently have the clinical signs of malignancy been observed when the encapsulated adenomas have been multiple and the malignant signs have

been present over one of the tumors. This is a very important thing to remember, because this knowledge will save an unnecessary mutilation of the patient. I have just noted under the heading Multiple Tumors, that they are usually benign, and if malignant never curable. Therefore, if there are multiple tumors and one of them clinically suggests malignancy, it is quite justifiable to explore this tumor.

Palpation of Encapsulated Adenoma These tumors (of the size of a pea, or a bean, or from the size of a ten-cent piece to that of a silver dollar)

are usually recognized as benign by the majority of surgeons. The most characteristic feature is their free mobility, no matter whether they are situated outside the breast, in the periphery, in the midzone, or in the nipple central area. Now and then they are felt in the axilla. They can be moved about like a marble beneath the skin. A malignant tumor rarely, if ever, has this free mobility, and, of course,



FIG 6 —Pathol No 15983. Microscopic picture (high power) of tumor shown in Fig 5. A papillary cystadenomatous area. The majority of the tumor resembled Fig 4.

encapsulated adenomas, do not always show it. The shape of the adenoma varies. But if one can palpate the tumor and it is freely movable, and spherical, it cannot be distinguished from a cyst. More often, however, the adenoma is not spherical, but somewhat lobulated, now and then like a mulberry. When we come to consistency, some of them are hard and firm, but never of the hardness of scirrhus cancer. Many are elastic and not infrequently, especially the intracanalicular myxoma, are doughy and semi-fluctuating.

It is very important, right here, to record the fact that a small, buried scirrhus cancer surrounded by oedematous breast tissue may give to the palpating finger a sensation of fluctuation and suggest a cyst or a softer encapsulated adenoma. The same is true of a certain type of medullary cancer.

Here, again, we have evidence of the difficulty of always distinguishing by palpation the benign from the malignant tumor. But if one will carefully record and try to memorize the sensations during the palpation of breast tumors, it is quickly found that the majority of encapsulated adenomas as well as blue-domed cysts are recognized by their mobility and their peculiar consistency and shape on palpation.

It is only in a relatively small number of cases that the palpation of the benign and malignant overlap.

Palpation of Larger Encapsulated Adenomas The moment a tumor

reaches the size of a quadrant of the breast, or larger, and is still freely movable, and has the palpation of the encapsulated adenoma, one must think of sarcoma.

There are two types of the larger encapsulated adenoma. One, more frequently situated outside the breast (aberrant adenoma) is of the fibroadenomatous type and has no tendency to sarcomatous change.

The larger encapsulated adenomas of the aberrant



FIG 7 —Pathol No 7135 Encapsulated aberrant fibroadenoma. Photograph of patient. The freely movable large tumor is upwards and to the right, the breast to the medial and lower side. The patient was sixteen years of age. Operation. Excision of tumor only, breast preserved. If this patient had been over twenty-five sarcoma in intracanalicular myxoma could not have been excluded. For gross appearance see Fig 8.

rant adenoma type can be distinguished from the larger adenoma of the intracanalicular myxoma type only by the age of the patient and the situation of the tumor. The adenoma of the aberrant breast type is observed chiefly at puberty and in young women under twenty-five years of age, it is usually situated outside the breast. I have never observed sarcoma in the intracanalicular myxoma type at an age under twenty-five, or to be situated outside the breast.

Therefore, a large tumor which on palpation suggests encapsulation in a woman under twenty-five years of age is as yet without an exception a benign fibroadenoma and can be removed and the breast saved, but a similar

large tumor in a woman over twenty-five years of age should be looked upon as suspicious of sarcoma, and either removed without exploration with the breast and major pectoral muscle or exposed for diagnosis

In going over a large number of these cases one is impressed with how frequently in the past the breast of a young woman under twenty-five has been sacrificed for the benign aberrant adenoma because of the clinical diagnosis of sarcoma, and how frequently local recurrence has taken place after the removal by enucleation, or removal of the breast only for these larger encapsulated adenomas of the intracanalicular type in older women

The Differential Diagnosis Between Smaller Encapsulated Adenoma and Sarcoma

Now and then sarcoma may be a smaller tumor and palpate like an encapsulated adenoma. As I have reiterated in this paper, one should always bear in mind the possibility of malignancy, so that when one makes the incision for the removal of an apparently benign tumor of the breast the divided tissues should be carefully inspected as the incision is made down upon the tumor. Should one in dividing fat or breast find any evidence of *œdema* the tumor should be treated as malignant and in the majority of cases it will prove to be sarcoma. The *œdematous* condition is easy to recognize. If on removal and bisection of the tumor the *œdema* is observed outside the capsule or within the capsule, sarcoma should be considered, and a frozen section made.

Sarcoma is never associated with fibroadenoma, only with intracanalicular myxoadenoma. One, however, must be familiar with the usual very cellular stroma of the benign intracanalicular type. A few sarcoma of the breast arise independently.



FIG 8—Pathol No 21406 Photograph of encapsulated aberrant adenoma, removed by Doctor Royster of Raleigh N C. Note the distinct capsule in the lower left quadrant. The remainder of the tumor had been removed with a thin zone of breast tissue. Only the young age of the patient in this case allowed sarcoma to be excluded.

My experience teaches me that the *adema* outside the tumor is almost positive of sarcoma, and one will quickly learn to recognize by inspection and from the frozen section the sarcoma in the smaller intracanalicular myxoma. As previously stated, every apparently encapsulated adenoma of the intracanalicular myxoma type which is larger than a quadrant of the breast, should be considered suspicious of sarcoma.

ENCAPSULATED ADENOMA MICROSCOPICALLY SUSPICIOUS OF CARCINOMA

Cystic Adenoma This is relatively infrequent. I have studied about 22 cases. The majority have been received in the laboratory from outside

sources with this history. The surgeon has palpated what he considered a benign encapsulated tumor, in removing the tumor he found it to be distinctly encapsulated and containing a number of minute cysts, either at the time of operation from a frozen section, or later, the pathological report has been "adenocarcinoma" or "suspicious of malignancy." The surgeon has been in a dilemma, and instead of performing the complete excision of the breast or the complete operation for cancer,



FIG 9.—Pathol. No. 7105. Unilateral hypertrophy of left breast in a girl aged sixteen. Large palpable tumor in inner hemisphere. Unnecessary complete removal of breast on diagnosis of sarcoma. For gross see Fig. 10.

he has submitted the section to other pathologists. In all of these cases there has been a divided opinion. In none has the operation been more than the removal of the tumor. I have followed every patient, some more than ten years—there is yet to be a recurrence, or any evidence of local or general malignancy.

This is still happening with about the same frequency. The gross and

BENIGN TUMORS OF THE BREAST



FIG 10—Pathol No 7105 Encapsulated aberrant fibroadenoma to right Nipple, areola and breast to left The large tumor to the right could have been removed and the breast saved The age of the patient excludes sarcoma

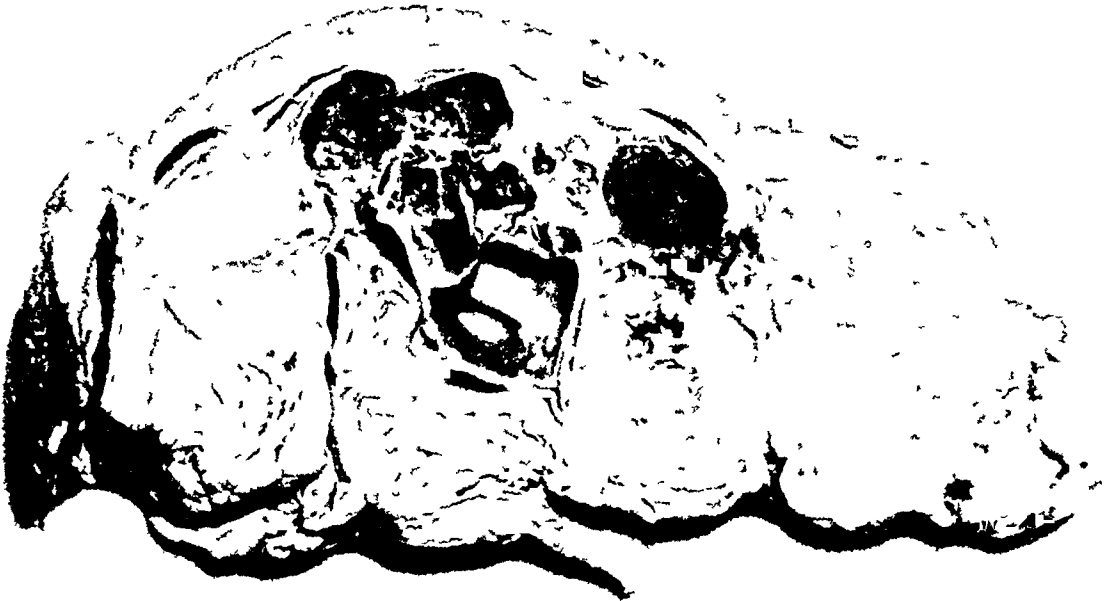


FIG 11—Pathol No 1085 Gross section through large tumor of the breast in woman over thirty years of age Chiefly an encapsulated cystic and solid intracanalicular myxoadenoma with sarcomatous areas Enucleation of tumor only Local recurrence in pectoral muscle Death due to infiltration of chest wall and lung The only distinguishing feature of this patient in Fig 11 from the patients in Figs 7 and 9 is the age If the large tumors are explored the aberrant fibroadenoma (Fig 10) is easily distinguished from the intracanalicular myxoma (Fig 11) Malignancy (sarcoma) has never been observed in the fibroadenoma no matter what its size, while sarcoma is the rule in large intracanalicular myxoadenomas

microscopic appearances of these encapsulated cystic adenomas microscopically suspicious of carcinoma are identical with 18 cases of non-encapsulated cystic adenoma, which I have reported in the *Archives of Surgery* for November, 1921, vol iii, pp 446 and 513 They are classed under BB-13-7 The chief difference was that the majority of the non-encapsulated cystic adenomas microscopically suspicious of malignancy were subjected to the complete operation for cancer These patients have also been followed and without evidence of local or general metastasis up to date



FIG 12 —Pathol No 29383 Small almost encapsulated sarcoma in intracanalicular myxoma This tumor palpated like a benign tumor At the exploration oedema was encountered and the nicked tumor was juicy like a sarcoma For this reason the complete operation for cancer was done The right photograph shows the tumor to right and the cauterized fat of the exploratory wound and the skin to left The partial obliteration of the capsule is quite distinct in the right photograph The left photograph shows a tumor almost encapsulated Compare with Fig 3-b The oedema outside the tumor and the juiciness of the tumor does not show For microscopic pictures see Figs 13 and 14

The practical question is what to do My experience teaches me that if the tumor is distinctly encapsulated, treat it as a benign tumor, unless it is an intracanalicular myxoma with microscopic appearance of sarcoma Then treat it as a sarcoma If the explored tumor is not encapsulated, treat it as a malignant tumor unless you are positive from the frozen section that it is benign This is a safe working rule It means that you will never do an incomplete operation for cancer, but now and then you will do a complete operation for a benign lesion

Fibroadenoma Much less frequently have the encapsulated fibroadenomas shown microscopic areas suspicious of cancer But in one group

BENIGN TUMORS OF THE BREAST

areas suspicious of cancer are quite frequent almost constant, and that is in the *calcified old fibroadenomas*. Here in zones of fibrous tissue we find nests of epithelial cells, remains of the old parenchyma, duct and acini arrangement is lost, basement membrane is not to be seen. You know it cannot be cancer, at least in a biological sense. These calcified tumors have been present for years and have remained quiescent. It is very important to remember this histological picture, because one now and then meets it in encapsulated fibroadenomas that are not calcified and in non-encapsulated tumors of the breast.

Intracanalicular Myxoadenoma. Very infrequently have such tumors been referred to the laboratory as suspicious of carcinoma, but every now and then, as mentioned before, the very cellular stroma of the benign encapsulated tumor has been looked upon as sarcoma.

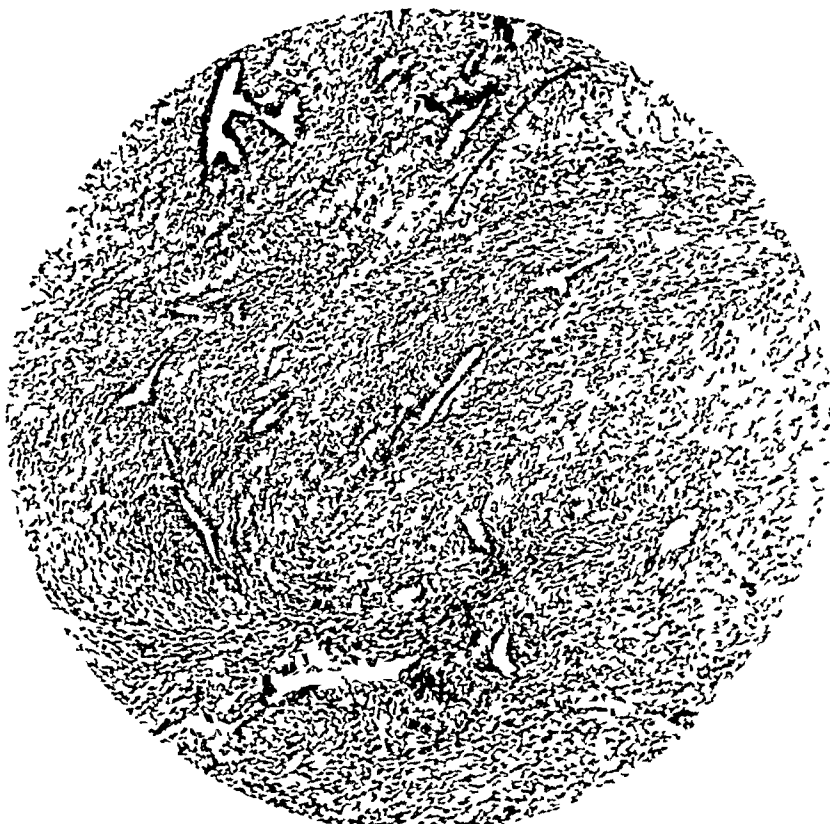


FIG 13—Pathol No 29383. Photomicrograph (low power) of intracanalicular myxoadenoma with cellular areas of sarcoma. For gross appearance see Fig 12. For high power see Fig 14.

THE ULTIMATE RESULTS IN PATIENTS OPERATED ON FOR ENCAPSULATED ADENOMA WITHOUT REMOVAL OF THE BREAST

It is now more than thirty years since the first operation of this kind in Halsted's clinic, and there is a record of almost 400 cases. In a large number the age of the patient at the time of operation has been over twenty-five years. Remarkable is the observation that up to date, none of them have returned with cancer of the breast. A small per cent have returned with a tumor in the operated breast, or in the other breast, and these tumors when explored have proved to be encapsulated adenomas. It seems strange that in such a large number of women, many of whom were at the cancer age at the time of operation, not one has returned with cancer of the breast. Another remarkable observation is that we rarely find encapsulated adenoma and cancer in the same breast. Billroth pictures an example of multiple encapsulated adenomas and cancer in the same breast. I have two such

examples, in which there was no evidence that the cancer developed in the adenoma but in the breast between

When we come to carcinoma, the same is true—practically all patients operated upon for cancer of one breast, when they return with a tumor in the other breast, this tumor with the rarest exceptions is also cancer. The simultaneous development of cancer in both breasts is very, very infrequent, but this is not so as regards adenoma.

How shall we explain cancer in tumors of five, ten, fifteen and twenty years' duration? In the first place, it is very rare. Many of them are areas

of chronic lactation mastitis leaving a residual scar tumor which has never disappeared. My observations prove this possibility, but as yet I have been unable to positively prove the development of carcinoma in preexisting adenoma. The removal therefore, of a distinctly encapsulated small quiescent adenoma is not based upon the theory that its removal will protect the patient from future cancer.

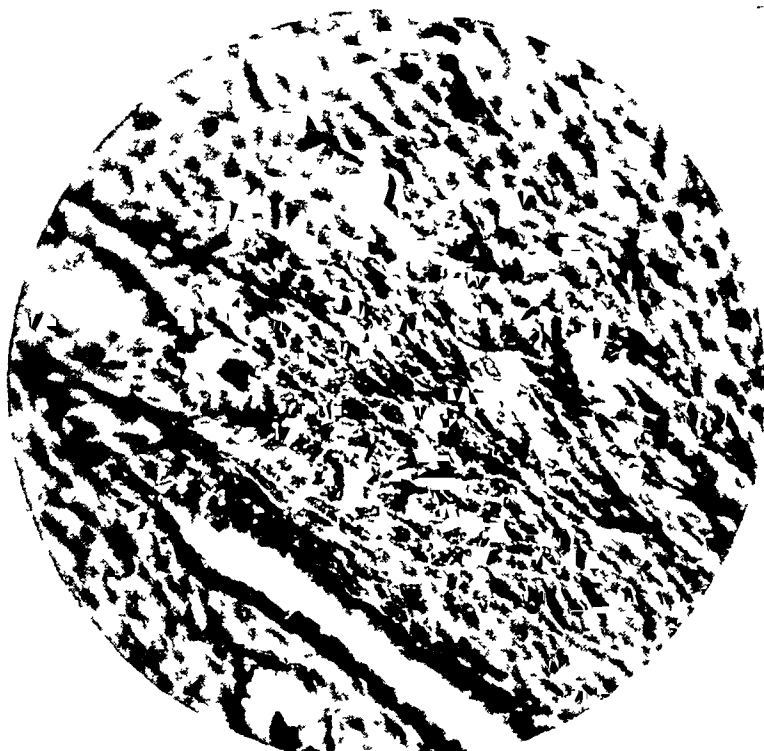


FIG 14—Pathol No 29383 High power photomicrograph Sarcoma in intracanalicular myxoma For low power see Fig 13 for gross see Fig 12

The object of such an operation is based upon the evidence that in the early stage cancer and adenoma cannot be differentiated. One operates because of the possibility of cancer and to give the patient the benefit of the earlier radical removal. If the tumor proves to be benign there is no difficulty in removing it without injury to the breast.

Adenoma in Pregnancy and Lactation Most of the encapsulated adenomas removed from the breast during pregnancy or lactation, which have been received in the laboratory from outside sources, came with the clinical diagnosis by the operator of a benign encapsulated tumor, and the microscopic diagnosis of "adenocarcinoma" or "suspicious of malignancy." Years ago, Billroth observed that adenoma of the breast like aberrant breast underwent the same histological changes as the breast during pregnancy and

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lactation, even to the secretion of milk, and if the pathologist is not familiar with the microscopic picture of lactation hypertrophy, the mistake of such an adenoma "adenocarcinoma" will be frequently made

A good reason for removing benign tumors in women under twenty and under twenty is that during a later pregnancy and lactation the tumor may enlarge with the breast, give pain, and more frequently great discomfort, and may make an operation necessary at a more inconvenient time. They also run a greater risk of a complete operation for cancer based upon an incorrect pathological diagnosis

Operations Upon the Breast During Pregnancy and Lactation

My records show that the removal of a benign tumor from the breast during pregnancy or lactation is devoid of complications on the part of the mother, her breast or the child. I am inclined to feel, however, that it requires greater skill. The breast in pregnancy is very vascular, and greater care must be exercised in controlling hemorrhage

and the closure of the wound. Otherwise there will be hæmatoma, inflammation, and mastitis. In operations during lactation one must expect a discharge of milk from the wound for a few days. It is my rule to have the child suckle and empty both breasts. Then immediately remove the tumor under anæsthesia, if possible, and the child can nurse again at the regular time



FIG 15.—Pathol No 13599 Encapsulated cystic adenoma demonstrated microscopically by many pathologists as suspicious of cancer or adenoma. Patient aged twenty-two. Capsule as distinct as in adenoma. Tumor and zone of breast only removed. No recurrence after e.g.

Exploratory Incision and Excision of Benign Tumors of the Breast—

As repeatedly emphasized in this article, the object of the operation, if the patient is over twenty-five, is not so much to find and remove a benign tumor, as to recognize quickly the possible malignant tumor and then to cauterize the wound chemically or thermally and to perform at once the complete operation for cancer

One only has to explore a few lumps in the breast to realize why the majority of surgeons prefer to remove the breast. This

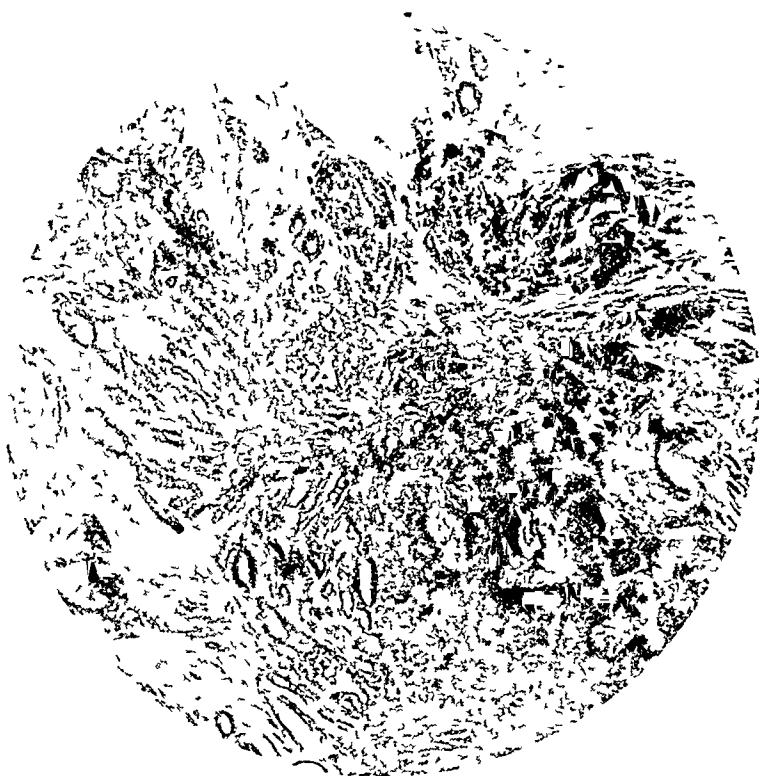


FIG 16 —Pathol No 26574 Section (low power) from a small distinctly encapsulated fibroadenoma, which might be interpreted as suspicious of malignancy. No recurrence after excision of the tumor only

is due to the difficulty of recognizing the benign from the malignant by the gross appearances, and even in the immediate frozen section. There is always the fear of cancer, the fear of overlooking cancer. Recently I have learned from some of my most experienced colleagues that they dislike to remove a lump from the breast, because they had difficulty with the healing of the wound after closure.

In my first ten years of experience in the diagnosis and surgery of breast tumors, my records show that if Doctor Halsted and his associates had performed the complete operation for cancer of the breast upon every woman who presented herself to the clinic, it would have been unnecessary in about twenty-five per cent of the cases. But during those ten years there was a sufficient number of benign tumors and doubtful tumors, to lead Doctor Halsted to develop his method of exploratory incision, recognition by the gross appearance only, and chemical disinfection, if the tumor proved to be malignant. During these ten years in only two instances was an incomplete operation for cancer performed, and in about ten per cent of the cases benign tumors were incorrectly diagnosed malignant clinically, or in the gross, or in the microscopic section.

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Since 1920, in many clinics, due to the education of the public, there has almost been a reversal in the relative frequency of benign and malignant lesions. In my own clinic it is now running about seventy-five per cent benign and twenty-five per cent malignant. It is important to note that of the seventy-five per cent benign two-thirds are not subjected to operation. Exploratory incision, therefore, is becoming more and more frequent and necessarily so.

From a diagnostic standpoint the explored tumor may be divided into three groups, the distinctly benign, to which belong the encapsulated adenoma, the blue-domed cyst of chronic cystic mastitis and a few distinctly benign intracystic papillomas and practically all single galactoceles. To the second group belongs the distinct carcinoma chiefly scirrhous and medullary, and most of the cancer cysts which are very rare. I also feel that the majority of surgeons should easily recognize colloid cancer as a non-

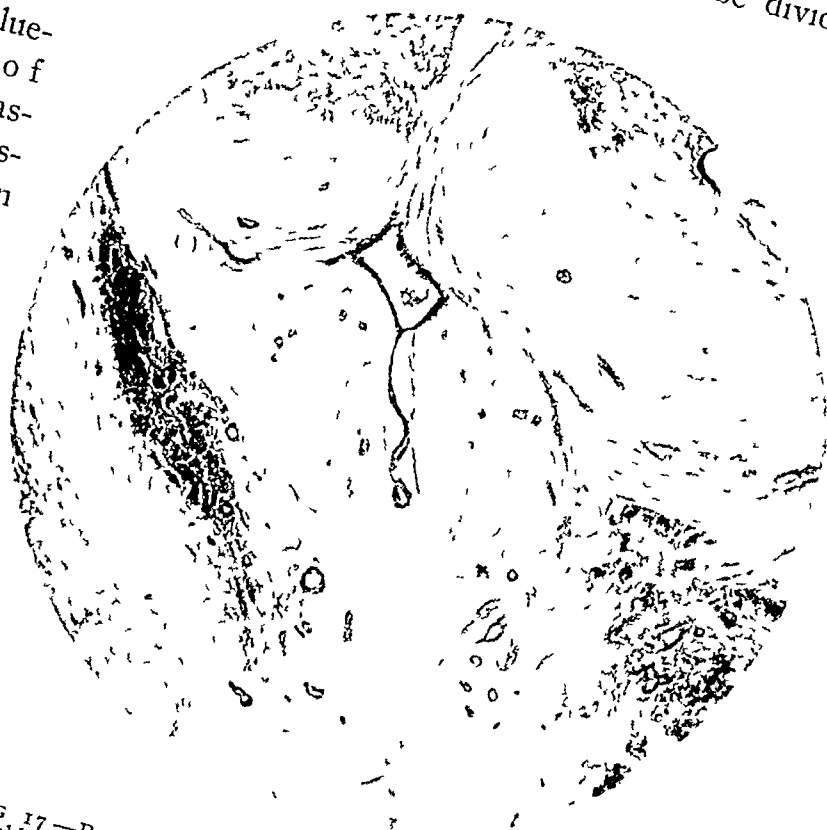


FIG 17—Pathol No 26517 Low power photomicrograph of typical fibrous old intracanalicular myxoma. Tumor the size of a bean. The cellular area (see Fig 18) is suspicious of malignancy.

encapsulated tumor which looks somewhat like colloid thyroid adenoma, and from which often gelatinous material can be expressed, and the non-encapsulated, circumscribed comedo, or duct cancer, from which worm-like masses of comedoes can be expressed on pressure.

These two great groups—the distinctly benign and the distinctly malignant—should be easily recognized in the gross, and the cancer cases are just as distinct in the frozen section. It is, important to recollect, as already brought out, that immediate and even permanent sections of the distinctly benign and encapsulated adenomas may reveal microscopic pictures suspicious of cancer. The same is true of the breast-tissue wall of a blue-domed cyst.

The third group is composed of non-encapsulated areas of breast tissue

which differ somewhat from the surrounding breast or of more definite tumor areas which differ from the encapsulated adenomas in the absence of a capsule and the inability to enucleate them or shell them out To this group also belong some doubtful cysts, some with and some without intracystic papillomas The areas, whatever their nature, are never encapsulated, although they may be circumscribed, and there may also be diffuse infiltration of the breast

At the operation of exploration, I gather from the evidence, the fear of cancer has more to do with their apparent resemblance to cancer than the real appearance of the tissues themselves

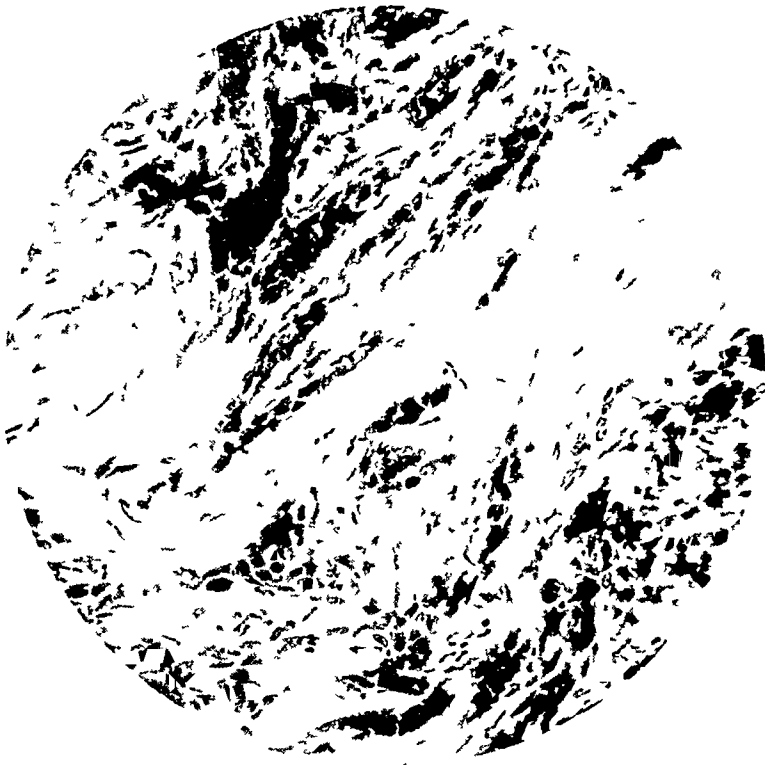


FIG 18—Pathol No 26517 High power photomicrograph of cellular area shown in Fig 17 Suspicious of malignancy Such areas are frequently seen in the very fibrous parts or calcified parts of old adenomas of all types whether encapsulated or not In this case the tumor only was removed and there is no recurrence

When these cases are studied in cold blood after operation, their benign nature is usually thoroughly understood

This group, however, even to the most experienced, presents difficulties, and there must be a working rule, that is, when in doubt perform the complete operation for cancer

I have evidence

to show that in many clinics throughout this county, this group is being correctly recognized as a benign lesion by many operators from the gross appearance at the exploratory incision and by many surgical pathologists from the frozen section

It is very important to record here that many of the cases in this third group are pathological processes which tend to spontaneous recovery, or to assume, in the later stages, a gross and microscopic picture typical of benignancy For example, tubercular mastitis before the stage of abscess and caseation closely resembles infiltrating scirrhus, in the stage of abscess and sinus it presents no difficulties

In the early years of the past quarter of a century, the patients of this third group either did not appear in the clinic at all, because the mass in the breast disappeared, or, if they did, it was so late that a correct diagnosis could be made clinically. Surgeons and pathologists saw these cases only at rare intervals, there was no organization or method for exchange of views or material. Now the opposite is true, and this third group is increasing in numbers, and in the past two years this pathological lesion is often

received in the laboratory after its local removal only and with the correct diagnosis. Nevertheless, the majority of surgeons must first attempt to be conservative and remove the tumor only in the encapsulated adenoma and the blue-domed cyst, the galactocoele, and the distinctly benign intracystic papilloma. Subject all others to the complete operation for cancer. Then study and restudy in the laboratory the clinical history, the

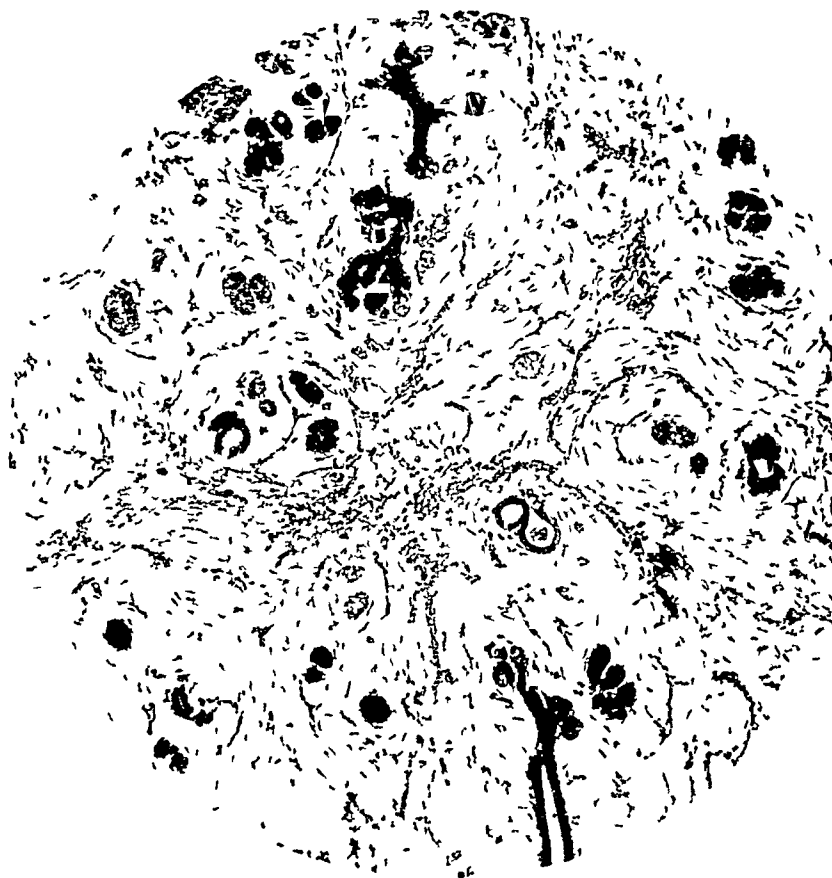


FIG 19 —Pathol No 21175 —The usual microscopic appearance of intracanalicular myxoma

gross specimen and the permanent sections of the third group, and prepare yourself to recognize this group more frequently at operation.

First Method of Exploratory Incision This is the method that Doctor Halsted employed, during the nine years of my association with him in the clinic at Johns Hopkins Hospital, and my later experience of twenty-three years, still finds it the method of choice, the one to be used in all suitable cases, which up to the present time represents the majority.

The method consists of cutting down upon the single definite palpable mass which has no definite signs of malignancy. The object of the incision is to ascertain the nature of the lump with the least possible exposure of uninvolved tissue and with the smallest wound possible, so that if cancer is found there can be an immediate chemical or thermal cauterization of the wound.

Palpable tumors have three definite positions. One, tumor tissue is at the surface of the breast, so that one cuts through skin and subcutaneous fat only. Two, the tumor is imbedded in breast tissue and one must cut through breast tissue before the tumor is seen. Three, the tumor is between the breast and the pectoral fascia. This is a very rare position, and in my experience only benign tumors—encapsulated adenoma and the blue-domed cysts are found in this locality. I have had now, more than thirty years' experience in making this form of exploratory incision. In every case in

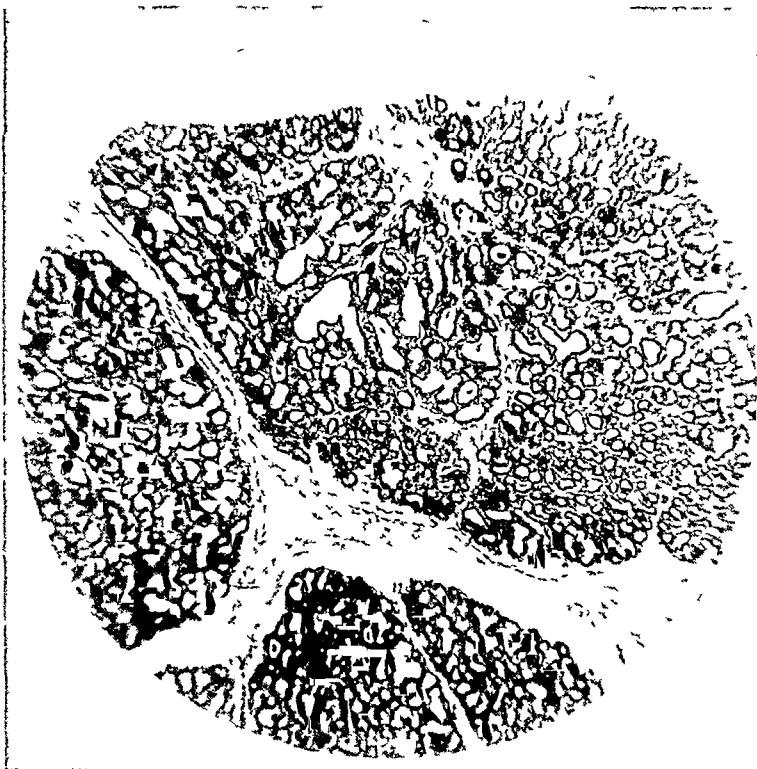


FIG 20.—Pathol. No. 26493. Lactation hypertrophy in an encapsulated adenoma removed during lactation.

which I assisted Doctor Halsted or Doctor Finney in the early years and in every case in which I was the operator, I have on record in the laboratory a written note of what was seen and felt at this exploratory incision.

Subcutaneous Tumors—When the breast tumor occupies the surface of the breast it has no covering but the subcutaneous fat. When a scirrhus carcinoma has reached

this point there is usually dimpling of the skin or evidence of atrophy of the subcutaneous fat or adherent skin, but when the tumor is a circumscribed scirrhus or a medullary carcinoma, or a cancer cyst, or a small sarcoma, it may palpate like a benign tumor and not be associated with changes in the skin or subcutaneous fat.

My recorded experiences and my memory of them emphasize one very important easily demonstrable feature. In cutting through the skin and subcutaneous fat down upon the palpable tumor and moving the knife from side to side, the benign tumor is exposed at once, readily, because the tissue is easily moved from the capsule of a benign cyst or encapsulated adenoma, while the tissue is more fixed to the malignant cyst or to the circumscribed or infiltrating area of cancer, and, as mentioned before, usually outside the more circumscribed sarcoma there is oedema. When the exploration is made

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slowly, one, so to speak, feels that the tumor is malignant before it is seen. If it is benign, a blue or gray dome of a cyst comes into view, or the distinct brownish-gray capsule of an adenoma. When one nicks the benign cyst the material is clear or cloudy, the galactocele contains milk, the cancer cyst has thick, grumous material. If the cyst contains blood it should be treated as malignant unless one can quickly demonstrate a distinctly benign intracystic papilloma. The contents of the cyst, therefore, is characteristic of the benign and of the malignant cyst.

The most characteristic feature about the benign encapsulated adenoma when it is exposed

beneath the subcutaneous fat, is its distinct capsule, the fact that it can be shelled out, that in separating it from the surrounding tissue one can see fine cobweb connective-tissue between the capsule and the surrounding fat or breast. I have never observed this in the malignant tumor. In a few instances I have observed oedema about an encapsulated adenoma, but in all

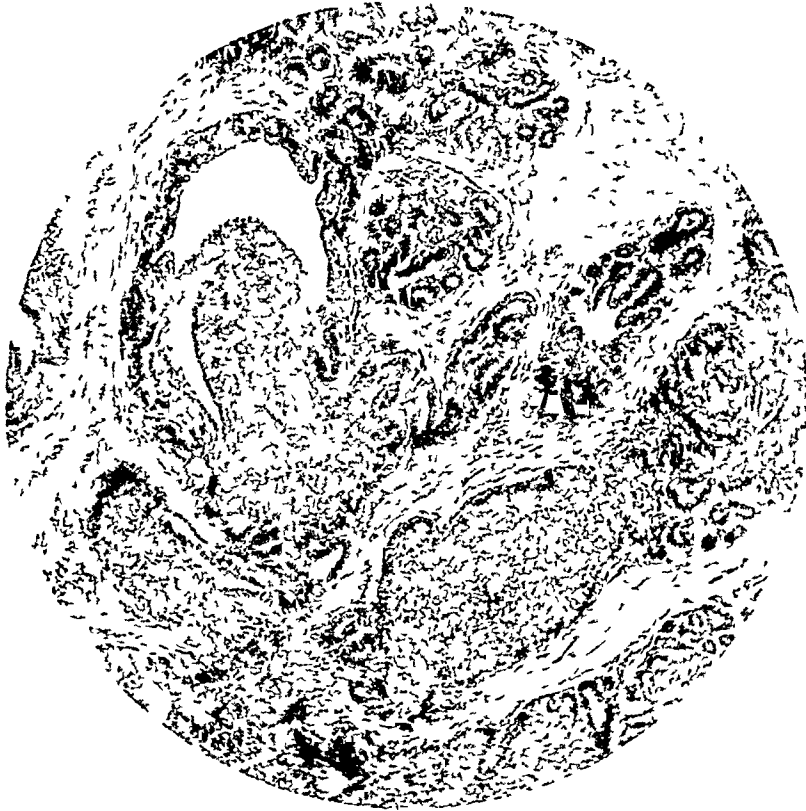


FIG 21—Pathol No 15518. Lactation hypertrophy suspicious of malignancy in an encapsulated adenoma removed at the end of lactation

of these cases there had been recent trauma, otherwise oedema has been associated with malignancy. It is therefore easier to distinguish the benign encapsulated adenoma from its surroundings, its enucleability and its capsule. When the tumor is cut into, it cannot be so readily distinguished from a sarcoma of the fibrosarcoma type, nor from a circumscribed scirrhous. Some small medullary carcinomas closely resemble the small intracanalicular myxoma.

The cancer cyst, whether arising in a papilloma or not, may have a blue dome. Its wall may resemble that of the benign cyst, but it is never as readily separated from the surrounding tissue, the cobweb tissue is usually absent, there is frequently oedema. (The blue dome over a cancer cyst has been seen only once in ten cases.) Fortunately, as stated before, the differ-

ential diagnosis is quickly made when we nick the cyst and examine its contents

I am beginning to feel that as our experience grows, we will be able to recognize the malignant cyst without cutting into it

When the tumor is buried in the breast tissue, one cannot recognize the benign from the malignant by the surface of the breast, exposed after

dividing the subcutaneous fat, nor is there anything characteristic in the breast tissue itself when it is divided, until one comes to the immediate surroundings of the tumor. Then what I have just described again holds true.

Second Method of Exploratory Incision—When the palpable tumor is very small, or the breast is large, fatty, I have found it more convenient to excise the palpable area with a good margin of surrounding breast and, after removal to place an alcohol sponge into the wound

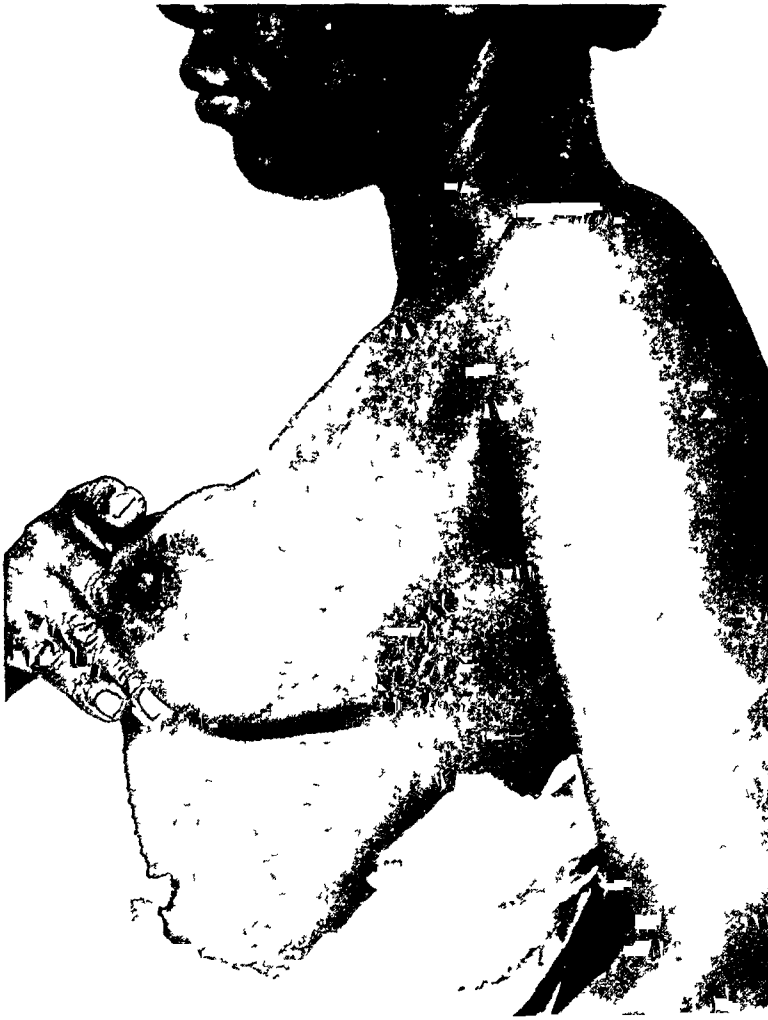


FIG 22—Pathol No 14430 The correct appearance of the breast after the excision of a benign tumor. The position and radiation of the incision varies. In this case the tumor was aberrant in the periphery towards the axilla. Note the symmetry of the breast is preserved.

Then take the tumor place it on a towel, hold it in the left hand, and with the knife in the right hand explore and bisect the tumor. This makes the differential diagnosis easier, it is better for a rapid frozen section, but I rarely employ it, except for the above indications. Perhaps for these surgeons whose experience is still limited, this might be the better method to employ.

Third Method of Exploratory Incision The idea comes from Warren, of Boston, who made a circular incision around the periphery of the breast turned the breast up and explored the palpable lump or lumps from the

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posterior surface I have known of this method since its introduction and publication, employed it on a few occasions many years ago, but abandoned it and found it a few days ago very satisfactory in a very difficult case

The patient was a young woman about twenty-eight years of age, unmarried, both breasts were large and of the diffuse virginal hypertrophy type. That is, their size was due to parenchyma and not fat. Both nipples were congenitally retracted. There was a definite palpable mass in the midzone of



FIG 23—Pathol No 21193 —Wound complication after excision of a benign breast tumor. Note that the symmetry of the breast is preserved. In this case a hæmatoma formed, became infected, and three incisions were necessary for drainage. But the breast was saved. Note the four skin scars.

the lower hemisphere. It did not have the movability of a benign tumor, was an irregular mass of indurated breast tissue of a type which I have described as mastitis. This palpable type is more frequently malignant than benign, except during lactation. The mass seemed buried in the breast tissue. When we moved the mass the congenitally depressed nipple pulled in further. All of us in the clinic concluded that it was malignant. In view of its situation deep in the hypertrophied breast, I decided upon the second method of exploration, but when the breast parenchyma was exposed I found it could be easily separated from the fat, and it occurred to me to follow Warren's method and look and feel at the involved area from the posterior surface. On doing so, palpation suggested a cyst. I then resected the

involved area, cutting through normal breast tissue, and then, on bisection, revealed a gray-domed, thick-walled benign cyst, and excluded malignancy

Plastic Closure The method still employed is the one taught me by Halsted in 1893, and during these thirty years it has been employed with success with increasing frequency. One change has been made after the first three cases. Silk is never employed, either for ligature or suture, in the plastic closure.

In removing the tumor, plan the excision as nearly as possible to a wedge-



FIG 24.—Photograph of patient showing the proper result after the excision of a benign tumor in the right breast and a faulty result in the left breast. The latter is due to failure to suture the breast defect—a definite plastic procedure (see text page 24)

shaped piece with the apex towards the areola or nipple. The skin incision should radiate from the areola. It is better to excise down to the pectoral fascia, except in very small tumors in large breasts. Every bleeding point should be ligated. The defect is closed with chromic catgut suture of 00 size, heavy catgut is not necessary. According to the thickness of the breast the sutures are in two, three or four layers. The first layer is posterior from nipple zone to periphery and the other layers follow, approximating the defect from the nipple outwards and from within outwards. The subcutaneous fat is approximated with catgut, and the skin is closed with interrupted fine silk passed with straight intestinal needles. If there is any puckering, remove the stitches and resuture. Even with a large defect, an

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irregular defect, this plastic suture is possible and the symmetry of the breast is restored to normal. The reduction in size of the breast varies with the amount of breast tissue removed. A perfect and an imperfect plastic operation are shown in Fig. 24 on the two breasts of the same patient.

The only complication has been a hæmatoma. In two of my cases which I dressed myself, the wounds healed by granulation, and the cosmetic result was as good as in wounds healing per primam. In a third the hæmatoma became infected, and multiple incisions were necessary to save the breast (Fig. 23). In one case the patient unfortunately was discharged with an unrecognized hæmatoma which became infected, and the breast was removed elsewhere. There are about 400 operations of this kind with these few hæmatomas, two definite infections and the loss of one breast.

Therefore, hæmostasis is essential. The next is the proper fixation of the breast with padding and bandage, important in all cases and essential in large pendulous breasts. It is our rule to re-dress daily in order to evacuate any serum



FIG. 25.—Pathol. No. 9808. Definitely encapsulated fibroadenoma buried in breast tissue. Removal of breast unnecessary.

by pressure, or immediately to recognize any hæmatoma and evacuate it.

The skin stitches are never removed until the fourth day, and then every alternate stitch only. All stitches are out on the sixth or seventh day. When tumor, incision and the breast are small, the patient often leaves the hospital the day after the operation. The larger the wound and the breast the longer the patient is kept quietly in the hospital, up to the seventh or tenth day.

The object of this operation, if the tumor is benign, is to save the patient from the mutilation of a disfigured or removed breast. Therefore, every care is essential in the plastic closure and in the subsequent proper dressing of the wound and fixation of the parts.

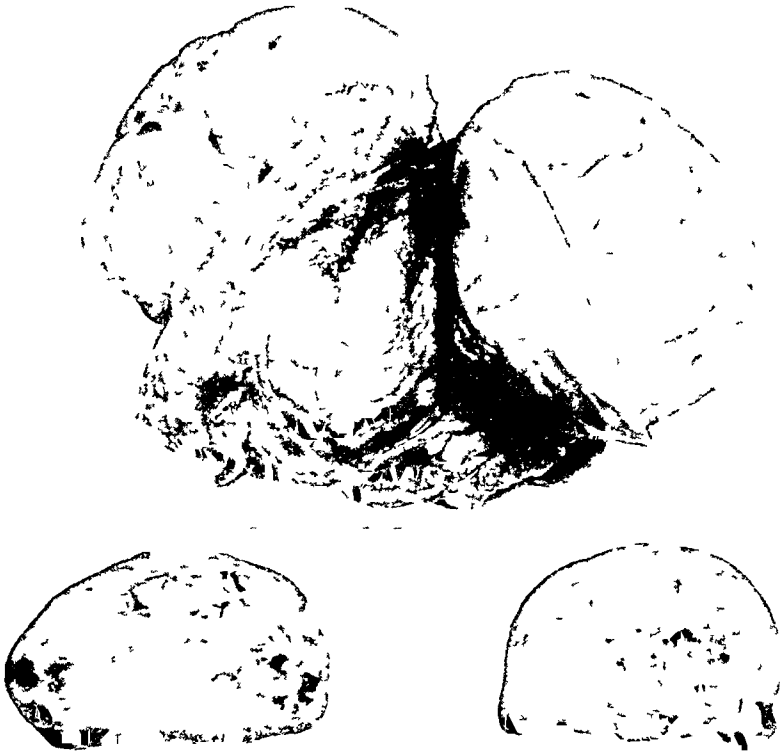


FIG 26—Pathol No 702 Encapsulated intracanalicular myxoadenoma To the right notice the capsule being peeled from the tumor To the left the surface of the capsule and the cut surface of the tumor

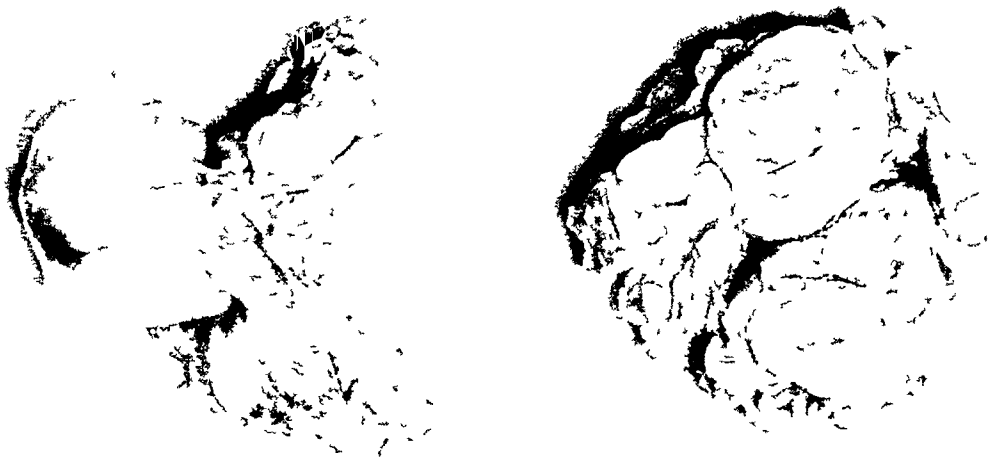


FIG 27—a and b Pathol No 31194 Encapsulated intracanalicular myxoadenoma removed with zone of breast The tumor is shown bisected with the surrounding breast b Pathol No 31194 Encapsulated adenoma Tumor with capsule above, breast tissue below The white lines represent the cob-web connective-tissue between the capsule of the benign tumor and the breast I have never seen this in malignancy It may also be obliterated by the inflammatory reaction of trauma (see Fig 5)

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Conclusions A colleague and a pathologist has just written me "Why remove benign encapsulated adenomas?" They are only isolated areas of normal breast tissue and as such have no more tendency to become malignant than the breast left behind after their removal" I trust this paper will answer his question I have tried to emphasize that the object of exploration is not to remove a benign tumor, but to expose and recognize a possible malignant tumor in the most favorable stage for a cure by the radical operation Having exposed a benign tumor, it requires very little more time to completely remove it, because the differential diagnosis often goes to a point where the benign tumor must be partially removed and in some cases completely removed before the differentiation from cancer is possible and made certain

There is a second reason for the removal of a benign encapsulated adenoma The evidence is that sarcoma usually develops in the intracanalicular myxoma type of adenoma It is quite possible that the malignant tumor giving a long history may have developed in preexisting adenoma

SOME OBSERVATIONS ON THE TREATMENT OF FRACTURE OF THE SKULL

REPORT OF ONE HUNDRED CASES FROM THE PENNSYLVANIA HOSPITAL

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AND

EDWARD A STRECKER, M D

OF PHILADELPHIA, PA

THERE have been several articles in the recent literature on fracture of the skull, the observations usually being from the service of one man, and treated by him or under his direction

The object of this paper is to present the results obtained from the treatment of such cases, in a general hospital, by numerous surgeons, where no special research has been done on the subject We fully realize that the best results are usually obtained under the intensive study plan in which all cases of a certain type are grouped under one man's direction, and where a comparison of technic, as shown by the improvement, if any, in the end results, can be noted with more accuracy

On the other hand, there are advantages in having more than one man's ideas in the management of cases, and such a method would possibly give a more accurate representation of what one may expect in the general treatment of such a class

For purposes of study, 100 fractures of the skull were taken in the order in which they were admitted to the Pennsylvania Hospital We fully realize that this number is far too small to warrant drawing any conclusions of value, and yet it may give a fair idea of the results to be expected in the ordinary run of fractured skulls as they are admitted to a general hospital

We are indebted to Doctors Harte, LeConte, Gibbon, Hutchinson, Stewart and Mitchell, upon whose services they were admitted, for the privilege of reporting them The X-ray examinations were made by Dr David R Bowen, and one of us (Doctor Strecker) made a neurological examination of such patients, as we were able to follow after leaving the hospital, these observations being recorded elsewhere in this paper

It is unfortunate that we were not able to trace more of our patients, but lack of sufficient personnel in the Social Service Department made such a task impossible We are indebted to this department for all of the replies that were received

Needless to say, a diagnosis of fracture of the skull is often a difficult one to make, and it is not the intention of this paper to enter into the question of differential diagnosis Only such cases were included in this study as

* Read before the Philadelphia Academy of Surgery, November 5 1923

THE TREATMENT OF FRACTURE OF THE SKULL

were definitely diagnosed as fractures by the Surgical Chief in charge, and yet to make the observations still more accurate, even this list has been further subdivided into "positive" and "doubtful" The latter class include those in which the clinical notes made by the resident are insufficient unfortunately so in some of the most interesting cases or where for one reason or another in reviewing the histories there seems to be a possible question as to diagnosis Bearing this differentiation in mind, they are all included under the general heading of fractured skull

Cases that were moribund on admission, dying within a few hours, are not included in this paper Forty-eight of this type, crushed, gunshot, etc, were admitted during the period over which our observations extended In a few instances the patients were sent from the receiving to the surgical wards, only to die within twenty-four hours These are included in our list, as it was thought they had a possible chance of recovery

Unfortunately the results of spinal puncture and blood-pressure were not recorded in the histories with sufficient regularity to be included in the general observations There is no question that had they been so mentioned, it would have made this study more complete, but we do not think, however, that even had they been included, they would have materially altered the end results

TABLE I
Location of Fracture and Age of Patient

Age	Base		Vault		Base and Vault
	Positive	Doubt	Positive	Doubt	Positive
1-10	1	2	16	0	2
11-20	3	1	10	0	0
21-30	4	1	12	0	3
31-40	8	4	3	0	2
41-50	12	0	7	1	1
51-60	1	2	0	0	1
61-on	1	0	1	0	1
	30	10	49	1	10

The difficulty of making a diagnosis has been mentioned In this series it was checked up either clinically by the X-ray or both

A comparison of the age of the patient and the location of the fracture, as seen by Table I, shows that the largest group was fracture of the vault in children under ten years of age, 16 cases Then followed the vault between twenty and thirty years and the base from forty to fifty years, each with 12 cases Only one "positive" and two "doubtful" fractures of the base were recorded under ten years of age

It was of interest to see how often the X-ray substantiated the clinical diagnosis, how many times it failed to do so and the occasions upon which the patient did not show clinical evidence of fracture, and yet it was revealed by the X-ray

Table II shows that when clinical signs of fracture of the base were present, the X-ray was negative or doubtful thirteen times and positive twelve. When clinical signs of basal fracture were absent or doubtful, the X-ray was negative twice and positive twice. The X-ray detected every fracture of the vault that gave positive clinical evidence and was positive in the four fractures of the vault that were clinically doubtful. In some cases for various reasons a picture was not taken.

On admission fifty-two of the patients were unconscious, stuporous or irritable, with or without bleeding from eye, ear, pharynx or mastoid, ten

TABLE II
Correlation of X-ray and Clinical Diagnosis

Clinical evidence of fractured base present	{ X-ray negative or doubtful X-ray positive	13 12
Clinical evidence of fractured base absent or doubtful	{ X-ray negative or doubtful X-ray positive	2 2
Clinical evidence of fractured vault present	{ X-ray negative or doubtful X-ray positive	0 34
Clinical evidence of fractured vault absent or doubtful	{ X-ray negative X-ray positive	0 4
Clinical evidence of fractured base and vault present	{ X-ray negative X-ray positive	1 10

showed paralysis in addition to the foregoing. In two there were no symptoms recorded and yet the X-ray showed a fracture. Eighteen were conscious and five were conscious, and in addition were paralyzed or bleeding, or both. Of the doubtful cases ten were in the first group—unconscious, stuporous or irritable—one showed paralysis in addition, one was conscious and paralyzed or bleeding and one was delirious.

A comparison of the type and location of the fracture in reference to mortality, with or without operation, as shown in Table III, shows that of the "positive" cases, four with a fissured fracture of the vault were operated upon and recovered and one died, of those not operated upon thirty-two recovered and one died. It is possible that some belonging to this group may have had a fracture of the base in addition, but if so, it was not recorded.

Of the depressed fractures of the vault, ten were operated upon, six recovered and four died, while in the non-operated group, five recovered and one died. It is needless to say that in this latter group the depression was not very marked.

The only certain case of fracture of the base that was operated upon died, as will be mentioned later. Of the "positive" cases of the base that were not operated upon, twenty-one recovered and eight died, of the "doubtful," not operated upon, three recovered and five died. There were ten cases of base and vault not operated upon, classed as base, of which number, seven

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lived and three died. One "doubtful" depressed fracture of the vault recovered with operation.

A summary of this list, Table III, shows that of all the cases operated upon, eleven recovered and six died, an operative mortality of 35.2 per cent. Of those that did not receive operation, sixty-three lived and twenty died, a mortality of 24.4 per cent. In comparing these figures it must of course

TABLE III
Location and Type of Fracture—Operated or Not Operated Upon—Recovered or Died

		Operated upon		Not operated upon	
		Recovered	Died	Recovered	Died
"Positive"	Fissure { Vault	4	1	27	1
	Base	0	1	21	8
	Depressed Vault	6	4	5	1
"Doubtful"	Fissure { Vault	0	0	0	1
	Base	0	0	3	5
	Depressed Vault	1	0	0	1
	Vault and Base			7	3
		11	6	63	20

be borne in mind that the cases operated upon were in a much more serious condition than the others.

One of the most difficult questions for us to decide in fracture of the base is: When should operation be done? A comparison of the results of operative and non-operative treatment as published by different men, varies widely. Even the most ardent supporters of the former would obviously not operate in every case of fracture of the base. Accordingly each case must be judged on its own merits, and what would be considered by one man as clear indications for surgical interference may not be so regarded by another equally competent observer. Hence the statement, "When in doubt, don't operate," is interpreted differently by various men.

From the fact that only once in this series was operation done specifically for fracture of the base, and this case died on the table, it is needless to say that at the Pennsylvania Hospital the conservative treatment has prevailed.

The mortality for decompression to relieve symptoms resulting from fracture of the base varies with different authors, averaging from 70 to 85 per cent. There is no doubt that several of our cases presenting serious symptoms have recovered without operation, and on the other hand, a goodly proportion of them died (34.0 per cent. of the non-operative cases).

This may be rather a high mortality for non-operated cases of fracture of the base, and yet we feel that undoubtedly by conservative treatment we have saved cases which more radical surgeons would have regarded as requiring operation.

As has been stated, the only case of fractured base that was operated upon, Case III, died as the trephine was started. He was a man of thirty-two, was having convulsions, and was sent to the operating room soon after being admitted. Following the advice of Doctor Frazier and others, no cases of fracture of the base are now operated upon within twenty-four hours of the time of injury.

Of the remaining cases of fractured base that were treated conservatively and died, the question naturally arises whether their chances for recovery would have been increased had an exploratory decompression been done. In this group, five died within twenty-four hours of admission, and two within forty-eight. It is presumably safe to say that each of these would have died in spite of any treatment. Of the others, three, classed as doubtful, lived four days, three for five days (one doubtful and two positive), one each for eighteen, twenty-three and twenty-five days, all "positive" cases. There are thus nine cases in which operation might possibly have been of benefit. Time and space prevent more than a brief resumé of these fatalities, sufficient to say that the surgeons in charge did not consider that operation was indicated.

In the "positive" class Case I was a man of fifty, who fell while under the influence of alcohol and was admitted in a semiconscious, very irritable condition. He was bleeding from the nose and both ears and showed weakness of the extremities on the left side, the facial muscle being weak on the right. The right pupil was dilated and immobile, the left contracted and reacting to light. He never recovered consciousness, the pulse varied from 48 to 116, temperature 96.3 to 102, and respirations 18 to 48. He died in two days.

CASE II—A man of forty-two, fell out of a window, was irrational on admission, bleeding from left ear and post pharynx, showed left facial palsy of the central type, and left hæmiplegia. Spinal fluid was bloody, under increased pressure, and the blood-pressure two days after admission was 140-95, and 120-70 on the fourth day. He died in five days.

CASE III—A man of thirty-two, unconscious on admission, showed convulsions starting in the right hand and then extending over the entire body. He was taken to the operating room and died just as the operation was started. The skull was opened over the parietal region and no evidence of increased intracranial pressure was noted. This is the only case of fracture of the base that was operated upon.

CASE IV—A man of forty-five, unconscious on admission, bleeding from the left ear, left pupil dilated and fixed, right moderately dilated. He was transferred to the surgical ward, never regained consciousness, and died the next day.

CASE V—A man of seventy-two, having fallen, was unconscious on admission, bleeding from left ear and nose. He rapidly developed pulmonary œdema and died within a few hours. The history notes say that he was so sick that no examination, spinal puncture, etc., was made.

CASE VI—A man of sixty-three, having fallen while drunk, was admitted in a stuporous condition. He was bleeding from both ears and pharynx. Spinal puncture showed blood-tinged fluid under normal pressure. He died in five days and post-mortem revealed a fracture of the parietal bone extending to the base.

CASE VII—A man of forty-nine, was admitted, having received a blow on the head. He was apparently conscious, for the resident who made the notes does not state otherwise. Three days later his spinal fluid was bloody, the tension not being increased. Twenty-four days after admission it was clear and under

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normal pressure. He showed Battle's sign and the X-ray revealed a fracture extending from the occipito-parietal suture to the petrous portion of the temporal bone. He died on the twenty-fifth day.

CASE VIII—A man of forty-seven, having fallen, was unconscious on admission. X-ray showed a fracture extending entirely across the cranium and middle fossa. He died on the eighteenth day and unfortunately there are no notes as to the progress of his condition.

CASE IX—A man of fifty-one, admitted in a stuporous condition, bleeding from the right ear, right arm flaccid, some paralysis of the right facial muscles, other parts of the body spastic, eyes deviated to the left. X-ray showed fracture of the right parietal and middle fossa. He developed some retraction of the head and stiffness of the neck and died in forty-eight hours.

CASE X—A man of thirty-two, fell and was semiconscious on admission. He showed bilateral subconjunctival hemorrhage and X-ray revealed fracture of the left frontal and anterior fossa. He also had a fracture of the femur. He gradually sank and died on the twenty-third day, showing signs of mental irritability up to the last.

The following four cases showed sufficient clinical evidence to be classed as fractures, but for the reason mentioned elsewhere they are included in the "doubtful" group.

CASE XI—A man of forty-five, unconscious and alcoholic on admission, bleeding from the nose, both eyes diverging to the left, the left one more so, bloody spinal fluid, lines on left side of face smooth, developed a partial paralysis of the right arm and leg. The other reflexes were not exaggerated on admission. Temperature 100 to 107, pulse 100 to 162, and respiration 24 to 65 before death. X-ray failed to show fracture of the base.

CASE XII—A man of fifty-three, unconscious from a fall, showed ecchymosis around the left eye. The right pupil was dilated and immobile, the left small, reacted to light and showed nystagmus. The right side of the body was spastic and the left flaccid. One hour after admission he moved the left side and the right was less spastic. Next day both sides were paralyzed and he died thirty-six hours after admission.

CASE XIII—A man of sixty, fell while under the influence of alcohol, was violently irrational on admission and showed blood in the right orbit. There was no evidence of paralysis. He had a chronic nephritis and myocarditis and was delirious most of the time, till he died two days later.

CASE XIV—A man of sixty, also fell while drunk and was delirious on admission. There was bleeding into the right orbital fossa which increased up to the time of his death, four days later. His pulse ranged from 84 to 120. Temperature 101-104. X-ray failed to detect fracture of the base. Unfortunately spinal puncture and blood-pressure findings are not recorded.

In recording the results of treatment, Table IV, a patient was regarded as being cured when all symptoms had cleared up before leaving the hospital. Improved applied to those cases, mostly palsies, that had not entirely recovered, and not improved included those mostly palsies that had grown progressively worse or showed no evidence of improvement at the time of their discharge. The last group are those ending fatally.

An effort was made to interview all of the cases that left the hospital, but this met with only fair success. Lack of sufficient personnel in the Social Service Department renders it at present impossible to keep track of all the patients leaving the hospital, and for this reason, and the fact that most

of our notices were returned unclaimed, we were only able to examine or hear from fifteen. This number is of course too small to warrant drawing any conclusions, but some of those examined were of interest. All of them had shown a definite fracture while in the hospital. Six were in good health at the time of our examination—four vault and two base—and had not been operated upon.

TABLE IV
Results of Cases Operated and Not Operated Upon

	Operated upon				Not operated upon			
	Cure	Improved	Not imp	Died	Cure	Improved	Not imp	Died
Base { "Positive" "Doubtful"	0	0	0	1	15	3	2	8
	0	0	0	0	6	1	0	5
Vault { "Positive" "Doubtful"	10	0	1	5	28	1	0	3
	0	0	0	0	0	0	0	1
Base and Vault	0	0	0	0	7	0	0	3
	10	0	1	6	56	5	2	20

One, a boy of six, with a fracture of the base, whose hearing had been impaired, showed this condition cured, but he had lost the sense of smell. Of five who were regarded as improved when they left the hospital, one, a man who had shown involvement of the seventh and eighth nerves, on examination, showed that the seventh had cleared up and his hearing had returned in his right ear and was improving in the left one. Another, showing a palsy of the seventh when admitted two weeks after having been injured, had improved in seventeen days when discharged, and examination later showed a complete cure. The same was true for another palsy of the seventh which developed twelve days after the injury. This had almost cleared up when she was discharged in forty-one days, and follow-up examination showed complete recovery. A man who had shown mental dulness cleared up in nineteen days, and another, admitted five days after the accident, complaining of headaches and with left facial palsy, was somewhat improved when discharged. A man of thirty-three, unconscious for three days developed a seventh nerve palsy on the seventh day, and was somewhat dull mentally. He cleared up mentally by the twenty-third day, but his palsy persisted. A man of twenty-nine, with a fracture of the base, who was partially deaf, reports his hearing as being much improved. A man of twenty-one, with a fracture of the base, had a facial palsy which cleared up, but at the time of examination complained of headaches, weakness in his right eye, irritability and forgetfulness.

The commonest complaint was more or less persistent headache, usually over the site of fracture if this was in the vault. A boy of eight, injured three years ago, had a fracture of the parietal bone and the base. While in the hospital he showed a paralysis of the seventh and eighth nerves on the left side, which cleared up before he was discharged. He has been in poor health since, has headaches, pains in the left ear, definite mental impairment, and his mother says he is incorrigible.

The other cases with complications cleared up while the patients were in the hospital and are classified as having been discharged cured. There were thirteen "positive" and three "doubtful" cases that suffered no com-

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plications other than being unconscious, irrational or bleeding, all of which cleared up without ill effects

Thus of forty-seven fractures of the base, five of the "doubtful" and eleven of the "positive" type, died, fifteen with a fracture showing complications lived and sixteen uncomplicated cases lived

The impression given from these observations the series is too small

TABLE V
Complications of Cases which Lived

	Cured Not operated upon		Improved				Not improved Not operated on	
	Vault	Base	Operated Vault	Base	Not operated Vault	Base	Vault	Base
Dizziness and head- ache	1	1/2B	0	0	0	0	0	0
Hearing	0	1 1/2A	0	0	0	1	0	0
Mentality	0	2	0	0	0	1	0	0
Vision	0	0	0	0	0	0	0	1
Paralysis	0	2 1/2A	1	0	0	0	0	5 1/2B
Spastic	0	0	0	0	1	0	0	0

Of the 18 cases with complications which lived, 15 were of the base and 3 of the vault

to warrant the term "conclusions" is that the conservative or non-operative treatment of fracture of the base is the method to be preferred

This consists chiefly in rest in bed, purgation and light diet Should palsy of a cranial nerve fourth, sixth, seventh or eighth be present at the time the patient is admitted or subsequently develop, without evidence of pressure on more vital areas, we do not consider that operation is indicated for its relief Many of these cases have cleared up spontaneously, and in those that persist it is felt the dangers accompanying a decompression outweigh its possible beneficial results

We endeavor to keep a patient with even a simple uncomplicated fissured fracture in bed at least three weeks, although many of them object to such a procedure and demand their discharge earlier

As a matter of form, one of the supposedly cerebrospinal disinfectants is usually administered, urotropine, etc., but we have not as yet seen an instance in which it has been proven of value Likewise, no harm has resulted from its use

Should signs of pressure develop which tend to progress and threaten life, exploratory decompression is of course indicated When therefore an honest doubt exists as to the advisability of surgical interference, it would seem that equally good if not better results may be expected by following the non-operative course of treatment

CONGENITAL SOLITARY KIDNEY*

BY DANIEL N. EISENDRATH, M.D.

OF CHICAGO, ILL.

Definition The term solitary or single kidney should only be used in connection with cases in which there is a complete lack of development of the opposite organ (A of Fig 1). Much confusion exists because not only older, but even recent writers, use the term "solitary" or "single" in describing the following conditions:

1 Cases of crossed ectopia (Fig 2). Here both kidneys have developed but have fused into a single mass, lying, as a rule, entirely on one side of the midline of the body.

2 Cases of hypoplasia (B of Fig 1). Here one kidney has failed to develop completely so that only microscopic evidence of its presence may exist in extreme cases. The normally developed kidney may thus be thought to be the only one.

3 Cases of cake kidney. Here both kidneys have fused to form a single mass, usually in the midline of the body (Fig 3).

4 Cases in which one kidney has been removed are often erroneously referred to, both in our own and in foreign literature as "solitary kidney."

The existence of a rudimentary ureter on the opposite side (C of Fig 1), or the fact that the ureter of the solitary kidney crosses the midline of the body to end in the opposite side of the bladder (Figs 4 and 5), and finally the presence of a reduplication of the renal pelvis and ureters in the solitary kidney, does not exclude the use of the term solitary or single in cases showing these variations.

Frequency The following statistics show much variation as to the frequency of the condition:

Donald Brown ¹	3 in 12,000 autopsies
Morris ²	1 in 3,370 autopsies
Guizzetti and Pariset ³	39 in 20,000 autopsies
Nauman ⁴	10 in 10,177 autopsies
Sangalli ⁵	3 in 5,348 autopsies
Rootes ⁶	1 in 600 autopsies
Reimfelder ⁷	1 in 400 autopsies
Motzfeld ⁸	10 in 10,000 autopsies
Ballowitz ⁹	1 in 617 autopsies
Engel ¹⁰	16 in 12,300 autopsies

In 77,812 autopsies, the condition was found eighty-five times, or a little over one in a thousand. The earlier statistics include many cases of crossed ectopia, hypoplasia, and even horseshoe and cake kidney, so that I believe a more recent observation like that of Motzfeld gives us a fairly accurate idea of the frequency of the condition, *viz* about one in a thousand individuals.

* Read before the Chicago Urological Society, November 22, 1923.

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Sex and Side It is rather difficult to draw any conclusions from autopsy reports as all who have made observations as to the relative frequency in males and females state that fewer autopsies are performed in women. From

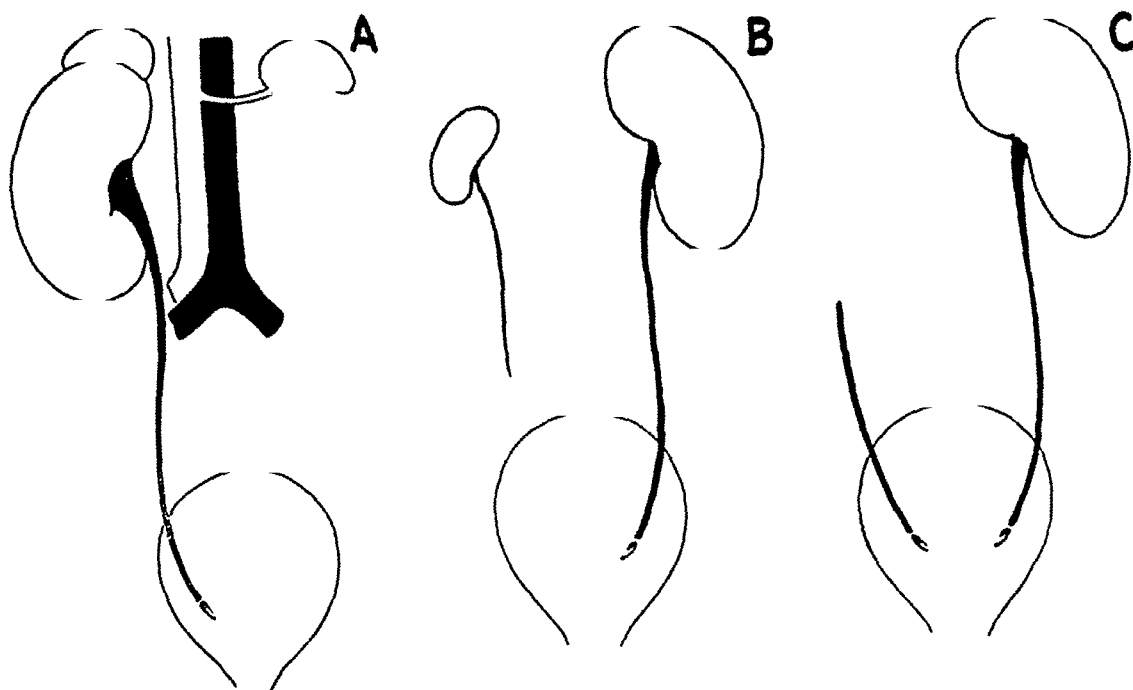


FIG 1—A Ureter ends on same side as that upon which kidney is located. Note almost constant presence of adrenal. B Kidney with normal ending ureter on one side, hypoplastic kidney with blind ending ureter on opposite side. C Kidney with normal ending ureter on one side with more or less patent ureter and absence of kidney on opposite side.

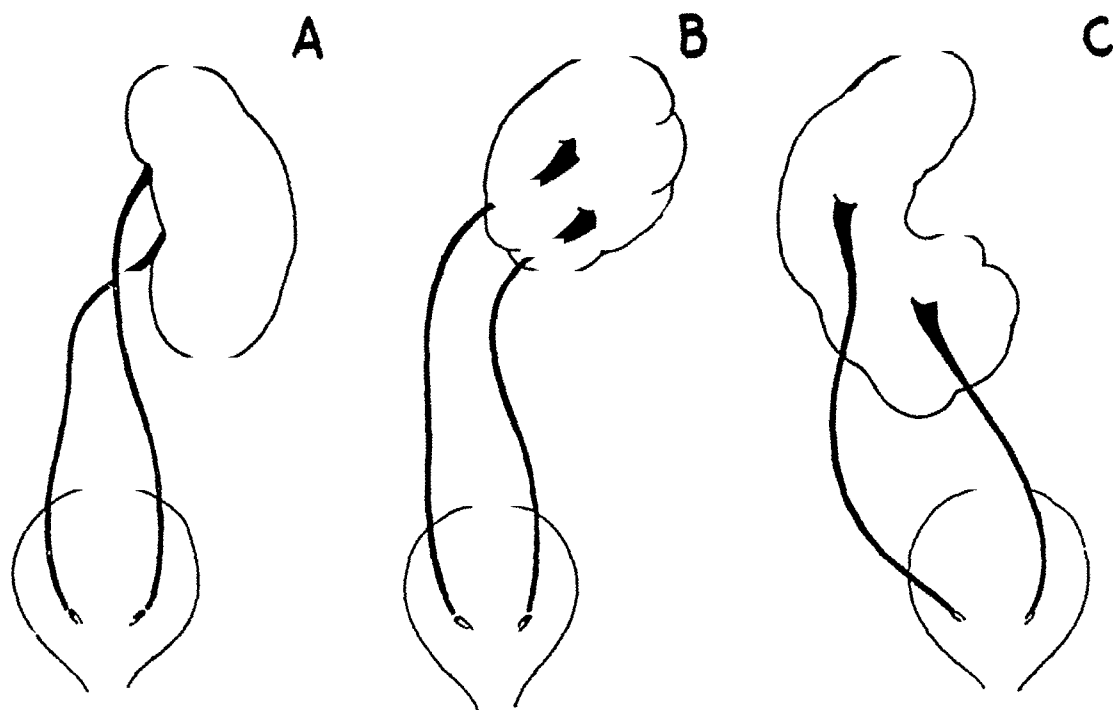


FIG 2—Various forms of crossed ectopia. Much confusion has arisen by describing such cases as 'solitary kidney' or 'unilateral fused kidney' (see text). A The two kidneys are fused into a mass resembling the form of the normal kidney. B Cake-like mass with pelvises on ventral aspect. C L-shaped mass, on one side of median line of body.

a study of all of the reports on this phase of the question, we can conclude that the condition occurs more often in males and also on the left side.

Number of Cases Reported Ballowitz⁹ was the first to collect a large series of cases. He reported 213 cases up to 1895. Anders¹¹ added 61 to

the largest number, 286 cases, which had been collected up to 1910 I have been able to find twenty-five recent additional cases, so that the total number of observations is about 400 Many of the older writers included the various anomalies which, as stated previously, should not be included in cases of true congenital solitary or single kidney, so that the total number is probably considerably less than the figures just given if one excludes such cases The majority of reported cases have been autopsy findings The number of

clinical cases (see tables) is only thirty-three

Anatomical Considerations 1 *Form, Size and Weight of the Single Kidney*—As a rule, the form varies but little from that of the normal kidney This applies to the organ when located in its usual position In the reported cases of ectopia of the solitary kidney there is mention of much alteration in form, the organ being flattened and irregular, as is the case in congenitally ectopic kidneys in general In comparatively few reports is the size mentioned M W Lyon, Jr,¹² states that in one case the measurements were 13 cm in length, 8.5 cm in width, and 4.5 cm in thickness

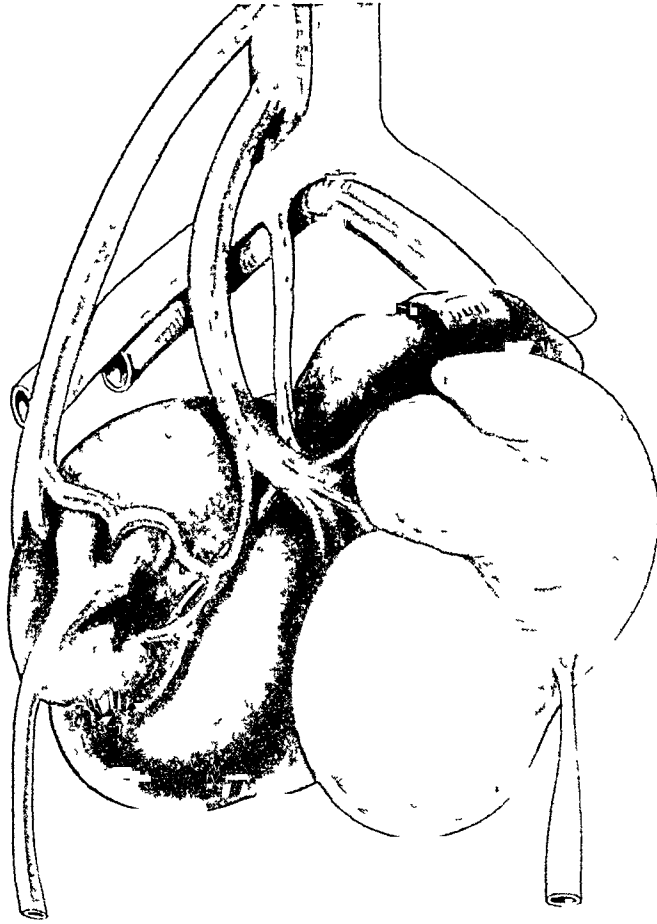


FIG 3 —Hydronephrosis of left half of pelvic ectopic cake kidney (Heimer)

In the other case they were 14 cm, 7.5 cm and 6 cm, respectively Ballowitz gives similar dimensions to the first of Lyon's cases In Jolly's case the kidney was 19 cm in length while in Chassaign's case it was only 11 cm long Winter in 237 collected observations noted that the kidney was very small in five per cent In a recent personal case the shadow of the kidney as measured on the roentgenographic film was 15 cm long and 10 cm wide The average weight as reported is about twice that of the normal kidney

2 *Location* As a rule this corresponds with that of the normal (Fig 6) Exceptions are when the kidney lies over the spine (Fig 7) or when it is ectopic (iliac or pelvic), (Fig 8) Winter,¹⁴ in a series of 237 collected cases, found the median location in two, the iliac ectopic location in three,

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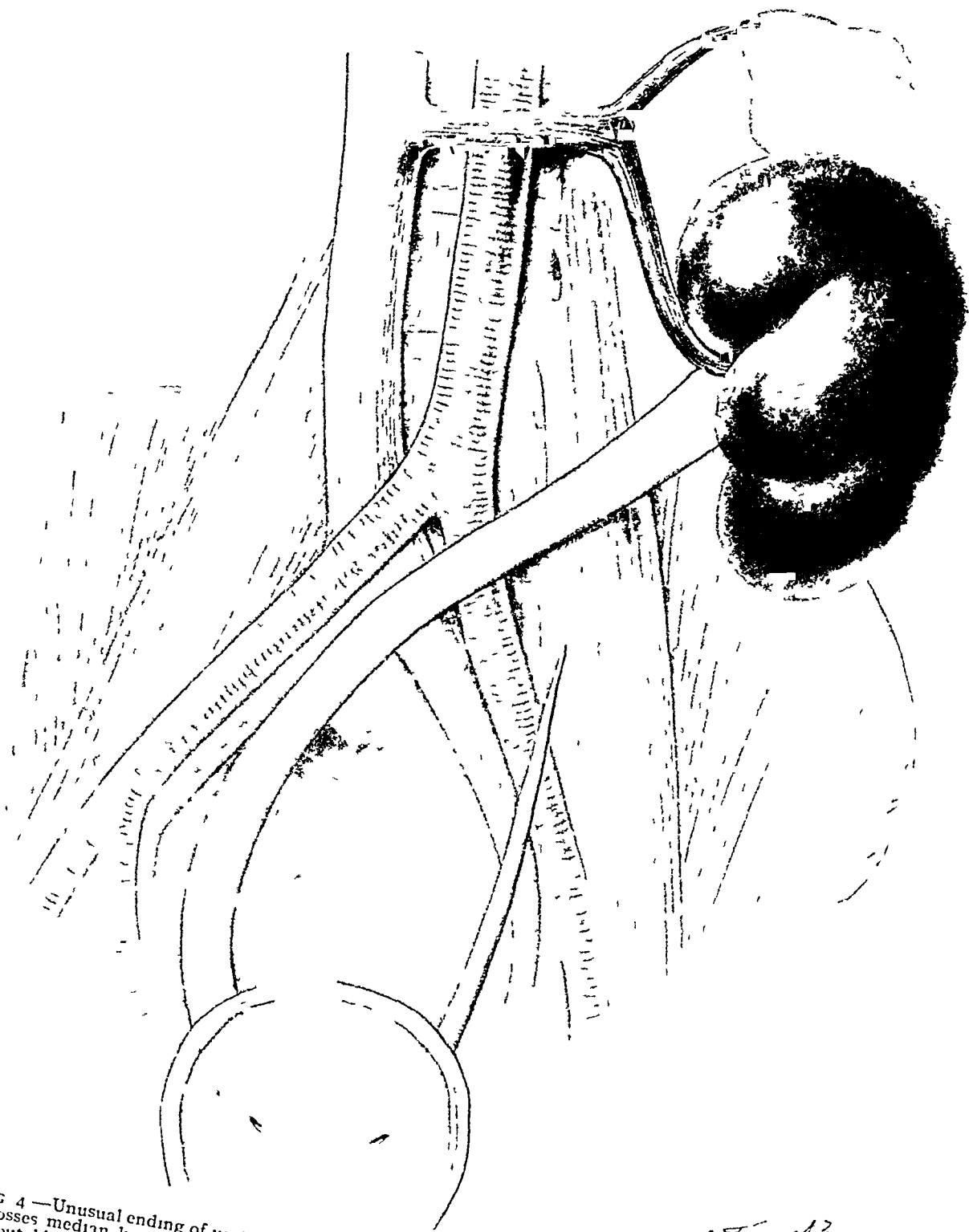


FIG. 4 — Unusual ending of ureter of congenital solitary kidney (Horand). Ureter of left solitary kidney crosses median line to end at right ureteral orifice. Left patent rudimentary ureter ends normally below but blindly above. Left seminal vesicle was absent.

and the pelvic ectopic location in five cases. I have found two additional median (Chavannaz and Rubens-Duval), three pelvic (Schultz, Buss and Strube) and one iliac (Heinricus) case. Papin¹ states that he was able to find reports of fourteen cases of ectopia of the solitary kidney.

3 *Variations in the Course and Ending of Ureter of the Solitary Kidney* Instead of the ureter ending on the same side of the bladder (Fig 6) as that upon which the kidney is situated, three variations may exist

(a) The ureter may end in the midline of the bladder (Fig 9) This occurred in seven cases

(b) The ureter may cross the midline and end in the opposite side of the bladder I could only find three reports of such an ending, the cases of

Lyon-Caen and Marnier,¹⁵ Horand¹⁶ and Forster¹⁷ (Figs 4 and 5)

(c) The ureter ends in the posterior urethra Schultz¹⁸ states that such a case has been reported, but I have been unable to find it

4 *Ureter of Opposite Side (Ending at Usual Place, i.e., Opposite Orifice)* —This is of much importance from the clinical standpoint because the presence of two ureteral orifices does not necessarily mean that two kidneys are present The ureter on the side opposite to that upon which the solitary kidney is situated may vary from a shallow depression or pouch to one which is patent for nearly half the length of

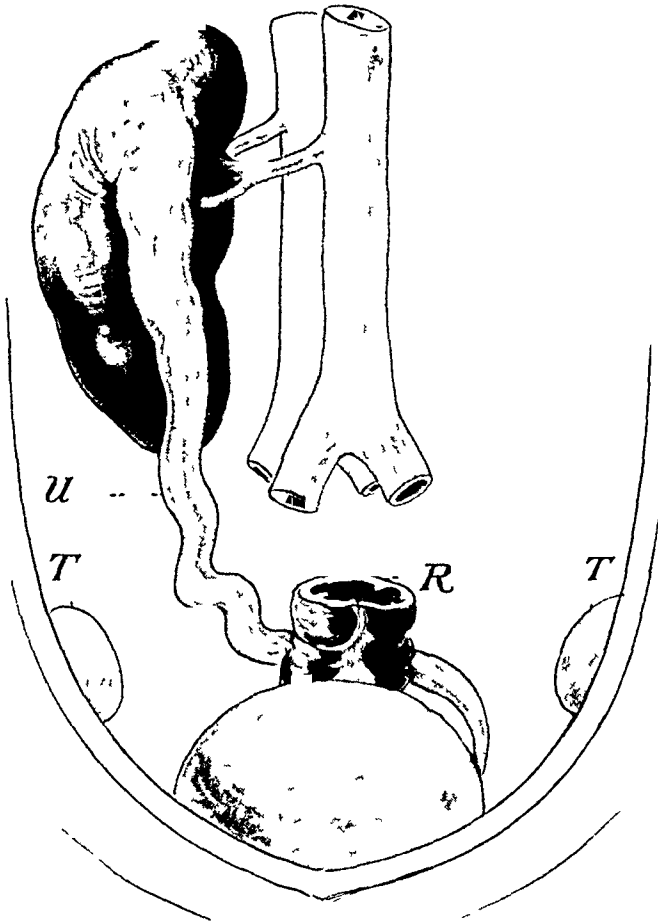


FIG 5 —Ureter of solitary kidney crossed midline to end in opposite side of bladder (Forster) U Ureter TT Undescended testes R Rectum Note how ureter passes behind rectum

the normal ureter In sixty-one cases Anders (*loc cit*) found the ureter absent in forty-two more or less patent in ten, and the condition not mentioned in nine reports of cases Winter found that the opposite ureter was present for a distance of at least a few centimetres in 18 of 237 cases I have found mention of the condition of the opposite ureter in a number of reports These are of much practical importance In Jolly's case it was patent for 1 cm and represented by a fibrous band for 13 cm In Winter's case it was patent for 8 cm, in Nebelow's case for 3 cm In Thevenot's case it was patent for half its normal length, while in five cases it was represented by a shallow cul-de-sac located at the place where the ureteral orifice should be

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5 Ureter of opposite side (abnormal endings) Instead of a rudimentary ureter (C of Fig 1) ending at the usual location of the corresponding ureteral orifice, the ending of the opposite ureter may be extravascular. It may end in the seminal vesicle¹⁹ (Fig 10) or form an intravesical protrusion²⁰ (Fig 11) or finally end in the wall of the cervix of a bicornuate uterus or in one horn of the latter²¹ (Fig 12)

6 Reduplication of the pelves and ureters of the solitary kidney Papin (*loc cit*) quotes five cases in which this condition existed. In all of these both ureters ended on the same side of the bladder as that upon which the solitary kidney was located.

7 Condition of the bladder trigone. The trigone may be either symmetric or asymmetric. In the former the interureteric ridge or ligament is developed as in an individual with two normally placed and developed kidneys. Instead of finding a ureteral orifice at both angles of the trigone the angle corresponding to the side upon which the kidney is absent, fails to show an orifice, often only an anæmic area taking its place. In the asymmetric trigone (Fig

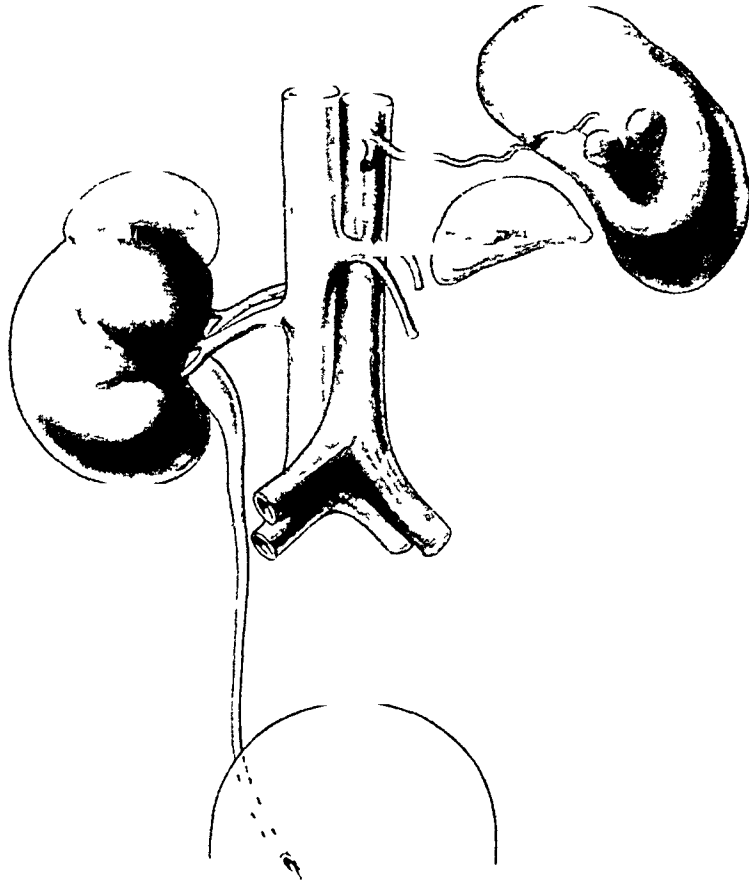


FIG 6—Typical findings in true congenital solitary kidney. Note ending of ureter on same side of bladder and presence of opposite adrenal (Renda)

13) the interureteric ligament flattens out into the wall of the bladder and only a few vessels indicate where the orifice should have been located.

In connection with this finding of a single ureteral orifice at one angle of the trigone, one must not fail to bear in mind such a case as that of Hepburn²² in which there was a single ureteral orifice normally located but two kidneys (Fig 14). The ureters from these united before entering the bladder.

8 Adrenals. These are absent in from ten to twenty-five per cent of the cases according to various reports.

Associated Genital Defects If one recalls the fate of the various structures which are present in the embryo (Fig 15), it is easy to understand

how genital defects † are associated with absence, lack of development, or malposition of the kidneys We will first consider those which are found in the male sex

(a) *Genital Defects in the Male* The recent statistics of Guizzetti and Pariset³ and of Engel²⁰ are more accurate as to the relative frequency of these defects than the older statistics of Ballowitz and Winter, because the

latter do not distinguish as was explained above between solitary kidney, hypoplasia and crossed ectopia Guizzetti and Pariset in a total of 39 autopsies on cases of solitary kidney, found defects of the male genitalia in 6 Engel in 16 solitary kidney autopsies found defects in 10 of 13 males These defects in the male may occur alone or in any combination

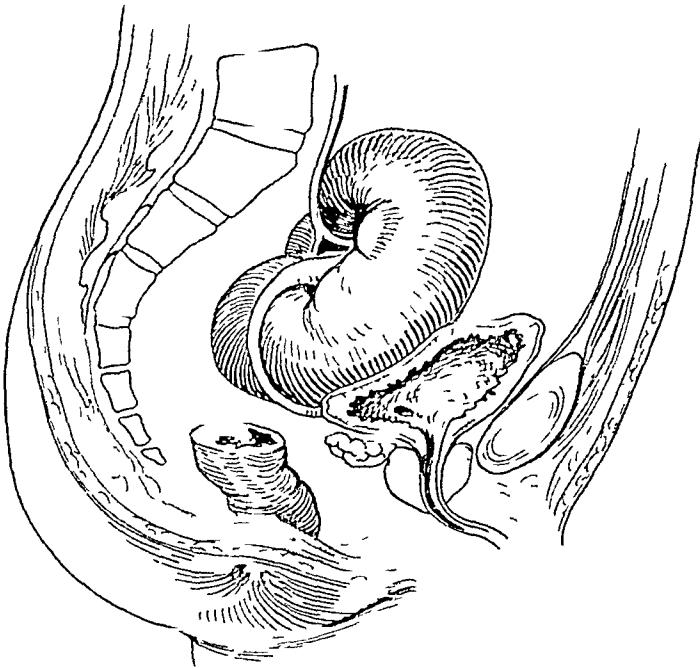


FIG 7 —Pelvic ectopic solitary kidney Pelvis directed to right Ureter entered midline of bladder Compare with Fig 9 (Schultz)

1 Rudimentary or absent seminal vesicle on the side where the kidney is absent

2 Rudimentary or absent vas deferens with or without a corresponding defect of the seminal vesicle

3 Atrophy of the prostate on the side of the renal defect

4 Absence of the ejaculatory duct on the side of the renal defect

5 Rudimentary or absent epididymes

6 Atrophy or absence of the testis The latter condition is rare

7 Absence of the seminal vesicle or of the testis on the side upon which the solitary kidney lies This only occurs in cases where the ureter crosses to end in the opposite side of the bladder In Horand's case the seminal vesicle was absent on the solitary kidney side

8 The rudimentary ureter ends in the seminal vesicle or in the vas This has been referred to in the description of the ending of the ureter on the opposite side (Fig 10)

† This diagram will aid in understanding how the ureter can end in the seminal vesicle The ureter is a bud from the Wolffian duct which becomes the vas deferens in the male In the female, the Wolffian duct disappears but from the duct of Muller develop the uterus and tubes

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9 Associated defects of the external genitalia, *e g*, hypospadias, non-descent of the testis, pseudo hermaphroditism

(b) *Defects of the Female Genitalia* Guizzetti and Pariset found defects in 5 of 39 cases (both sexes) of solitary kidney Winter, in a total of 237 collected cases of solitary kidney (some of which were undoubtedly other renal anomalies), found that nearly one-third had defects of the female genitalia

Eismayer¹ has recently collected 122 cases of genital defects in the female associated with solitary kidney These defects in the female may occur alone or in any combination

1 Uterine defects

(a) Uterus unicornis with or without (Fig 16) rudimentary second horn

(b) Bifid uterus

(c) Uterus didelphys

(d) Uterus duplex (Fig 12)

2 Tubal defects

(a) Absence of the tube on the side of the renal defect (very rare)

(b) Rudimentary tube or only abdominal end present

3 Ovarian defects

(a) Absence (very rare)

(b) Atrophy associated with similar condition of the corresponding tubes

4 Vaginal defects

(a) Absence or rudimentary development

(b) Atresia

(c) Double

(d) Recto-vaginal fistula associated with atresia of the rectum

5 Defects of the external genitalia, *e g*, absence or rudimentary development of clitoris or labiae

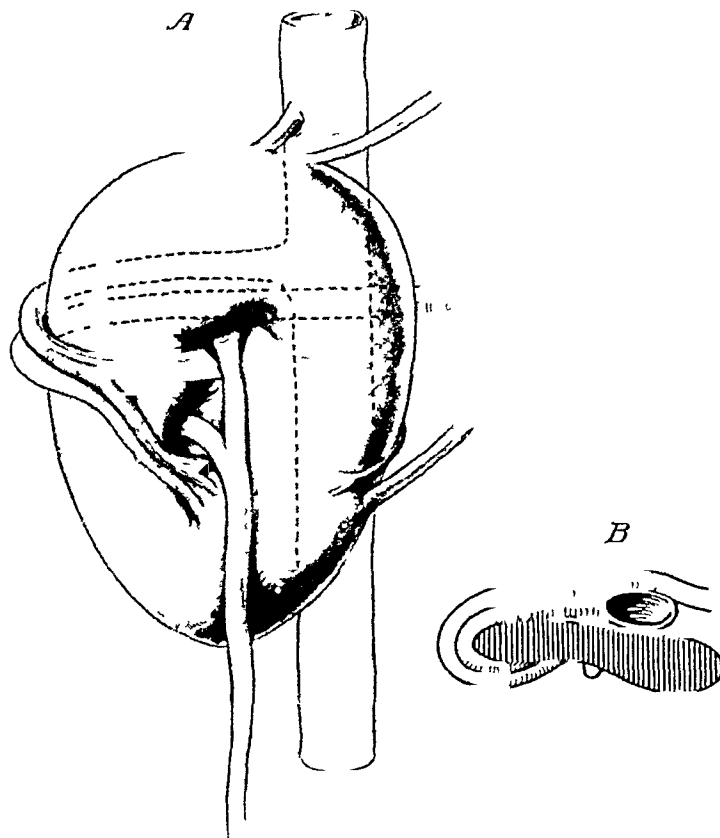


FIG 8—Ectopic median solitary kidney lying over aorta (Lejars and Rubens-Duval) Note how vessels wind around right edge of kidney to enter pelvis A Anterior view B Relation of aorta and venous cava to kidney

6 Abnormal ending of the rudimentary ureter in the wall of the cervix or in one horn of a bifid uterus Two such cases have been reported by Weibel (Fig 12)

It is of interest to quote some statistics regarding the frequency of some of these defects in the female

WINTER 237 cases of solitary kidney In 3 absence of the uterus, in 2 absence of the vagina, in 4 absence of the ovary, in 2 a double vagina

GUIZZETTI and PARISET—in 39 cases of solitary kidney One uterus bicornis, two uterus unicornis, one had absence of vagina and uterus and one the same condition plus absence of the tubes

BALLOWITZ—in 213 cases solitary kidney There were 18 cases of uterus unicornis and 10 of bifid uterus

BOLAFFIO²⁴ in 99 collected cases of defects of the female genitalia associated with renal anomalies there were noted

Uterus unicornis with opposite rudimentary horn—12 of 13 had a solitary kidney

Uterus unicornis without opposite rudimentary horn—19 of 24 had a solitary kidney

Uterus bicornis—25 of 34 had a solitary kidney

Rudimentary uterus—10 of 19 had a solitary kidney

Absence of the tubes alone—3 of 3 had a solitary kidney

This shows that female genitalia

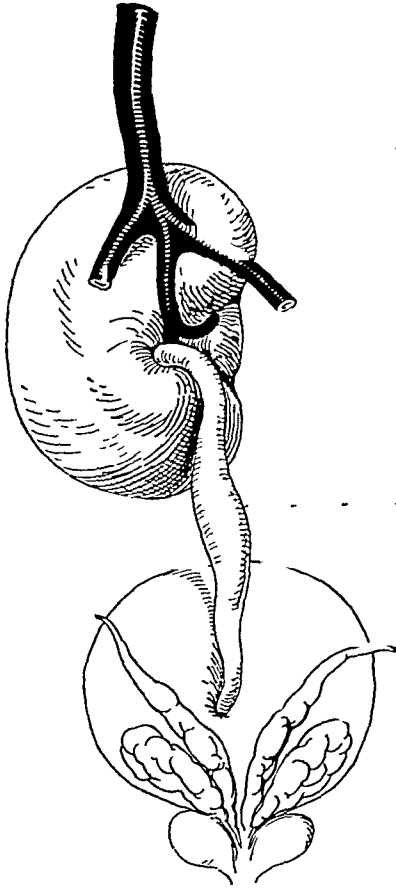


FIG 9—Posterior view of pelvic ectopic solitary kidney whose ureter ended in midline of bladder Compare with Fig 7 (Schultz)

defects occur far more often in connection with complete lack of development of the kidney than in association with any other renal anomaly

Clinical Considerations The importance of being able to recognize the presence of a congenital solitary or single kidney (as defined above) cannot be underestimated With our present diagnostic resources this should be possible in a far larger number of cases than in the past The kidney in these individuals is subject to the same diseases and injury as when two organs are present at birth In the case of congenitally displaced forms of solitary kidney (median, iliac or pelvic) there are the same predisposing mechanical factors to such conditions as calculus formations and hydronephrosis, as one finds in other congenital anomalies (horseshoe kidney, ectopia, hypoplasia and crossed ectopia) The menace to the carrier of the blocking of his or her

CONGENITAL SOLITARY KIDNEY

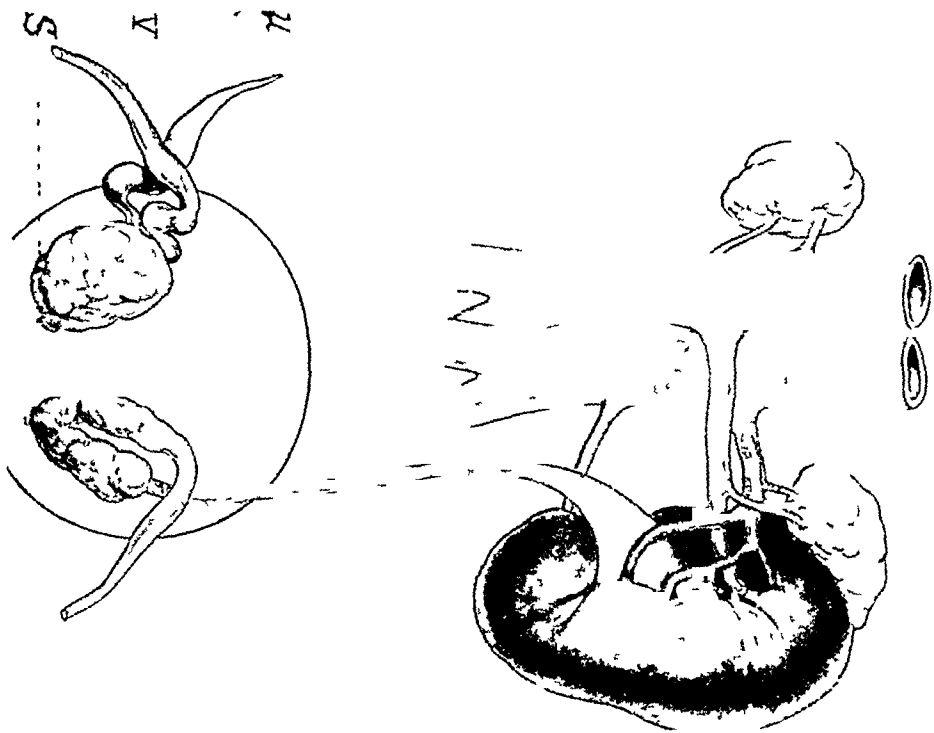


FIG 10.—Opposite rudimentary ureter U Ends in seminal vesicle VS Vas deferens (Erhardt Schmidt)

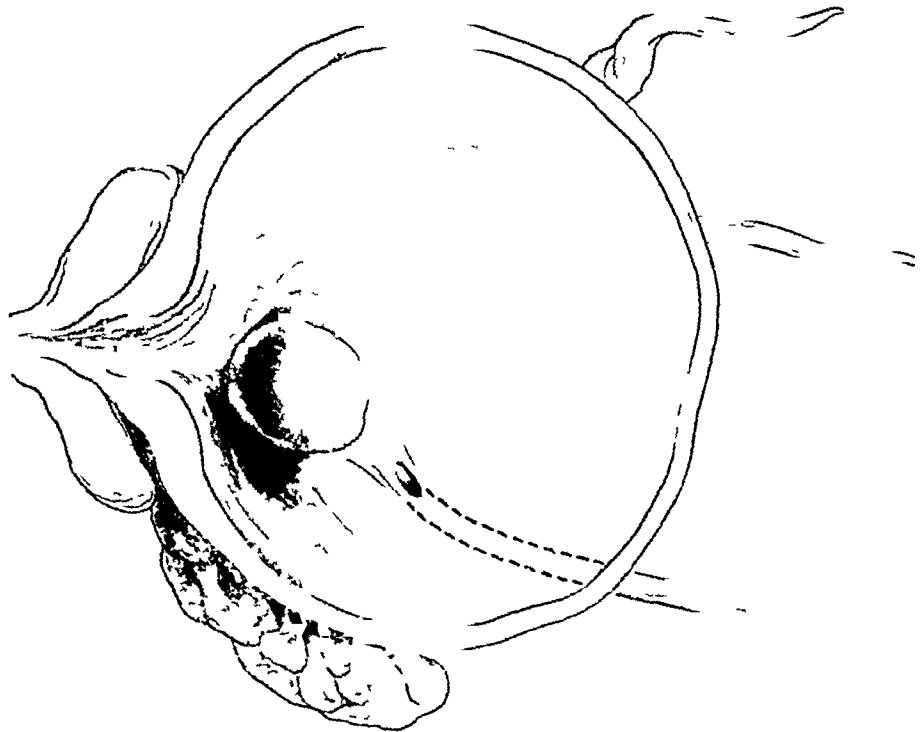


FIG 11.—Opposite ureter ends in seminal vesicle which forms intravesical protrusion (Desider Engel)

only kidney by some form of obstruction, emphasizes the necessity of an early diagnosis of such a possibility

A review of all of the published cases reveals the fact that a diagnosis before operation or the inception of non-operative measures has only been made in so few cases that an additional one may be of interest

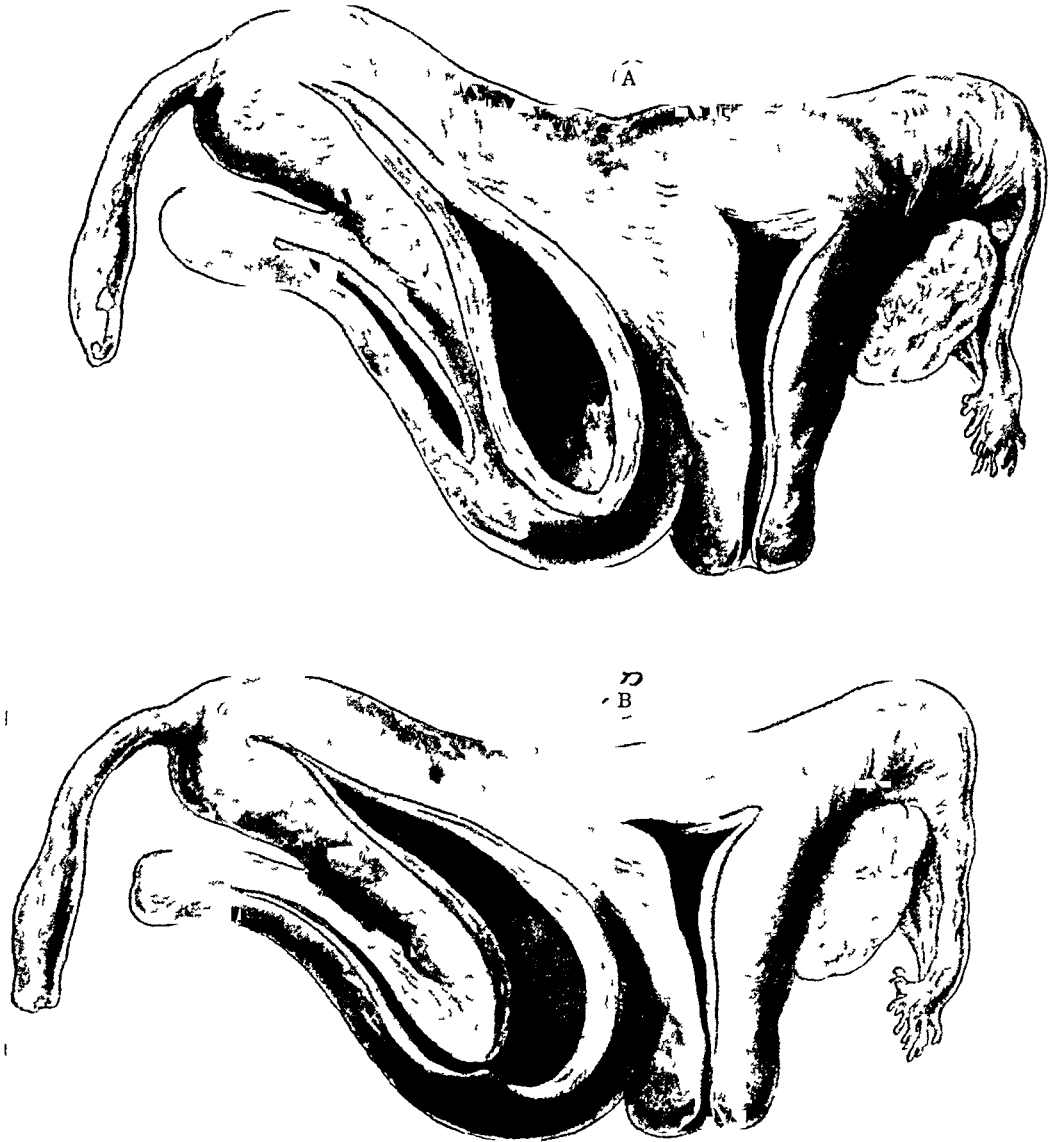


FIG 12 —Associated genital and renal anomalies (Weibel's cases) Case A View of rudimentary ureter ending in wall of cervix. The opposite kidney (solitary) and ureter were normal Case B View of rudimentary ureter ending in dilated cervical canal. The opposite kidney (solitary) and ureter were normal

Male, forty-nine,† first seen with Dr Frank Wright on account of a hæmaturia in April, 1923. There was a history of influenza and recurrent tonsillitis. Two weeks after an attack of the latter, hæmaturia was observed. Aside from a hypospadias (opening just behind glans penis) physical examination revealed nothing abnormal. A much reddened trigone and a moderately enlarged prostate

† This case has been reported in abstract form elsewhere

CONGENITAL SOLITARY KIDNEY

was found at the cystoscopic examination in April, 1923. Clear urine was observed to escape from the normal appearing left ureteral orifice and the notation made at the time that the right orifice was very difficult to find. Ureteral catheterization was postponed to a second sitting, but inasmuch as radiography revealed no abnormal shadows indicative of calculi and there was a temporary cessation of the hæmaturia, the patient did not return for further study. The hæmaturia recurred at intervals during the interval between the above examination and September 3, 1923, when he was again seen with Dr. Lester E. Garrison about twelve hours after the onset of such severe left colicky abdominal pain that opiates gave no relief. Shortly after admission to the Michael Reese Hospital, late the same evening, the



FIG. 13 —Asymmetric trigone with absence of left ureteral orifice in congenital solitary kidney (Bretzner)

chief complaint was a persistence of this pain localized in the lower left quadrant of the abdomen and radiating towards the left kidney region. The bladder was found to contain only 8 cc of a bloody fluid. A tentative diagnosis of left calculous anuria was made and active interference postponed until the next morning, as it was deemed safe to wait another twelve hours in order to have another roentgenogram made.

No abnormal shadows indicative of calculi were found, but it was noted that the shadow of the left kidney was very large. It measured 15 cm in length and 10 cm in width. The bladder contained only a few drops of bloody fluid. Cystoscopy revealed a slightly prominent left ureteral orifice, but no right-sided opening could be found. The trigone was symmetric and at its right angle was a pale area where the orifice should be located. A number five ureteral catheter after meeting with resistance in the pelvic portion of the ureter, could be passed to the kidney. At first a bloody fluid escaped followed by a steady flow of clear urine in large amount. The abdominal pain and the anuria having been relieved, further search was made in all portions of the bladder and posterior urethra for a

second ureteral orifice. None was found and indigocarmin although excreted in fair concentration from the left ureteral catheter, was not observed to escape elsewhere.

During the next twelve hours 250 cc of urine was collected from the left indwelling ureteral catheter and a further 800 cc during the following twenty-four hours. Nausea and vomiting ceased as soon as the anuria was relieved. The absence of a right ureteral orifice was confirmed by Dr. Frank M. Phifer at a later cystoscopy at which indigocarmin again failed to be excreted on the right side of the bladder. The left ureteral catheter was withdrawn on the third day, but it was necessary to reinsert it because the anuria and abdominal pain recurred.

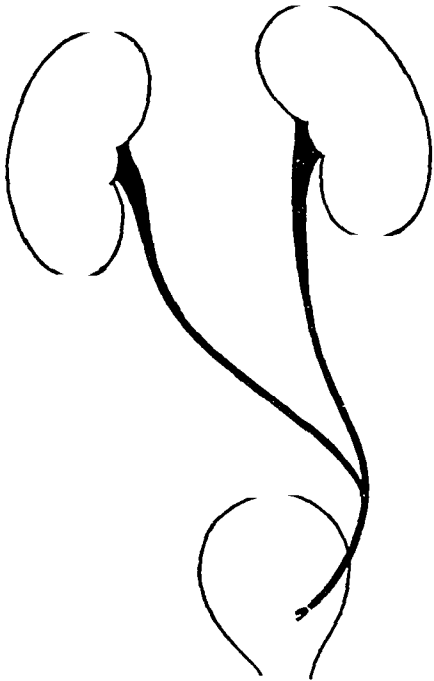


FIG. 14.—Diagram of Hepburn's case in which the two ureters united to end in a single ureteral orifice. (See text.)

On the fourth day the catheter became blocked so that a left pyelotomy or ureterotomy became imperative. The latter operation seemed preferable in order to determine the nature of the obstruction in the left ureter. The latter was found greatly distended and thin-walled down to a segment about one inch in length just above the bladder. This portion was very much smaller, indurated and impermeable. In order to exclude the possibility of overlooking a small calculus, the bladder was opened through a second suprapubic incision and a retrograde attempt to pass the blocked segment of the pelvic ureter. Inspection at this time of the right side of the bladder also failed to reveal the presence of a right ureteral orifice. The ureterostomy relieved the pain and anuria which had followed the occlusion of the indwelling ureteral catheter on the fourth day. Although a large quantity of urine was passed through the ureterostomy wound not a drop escaped for the first five days through the suprapubic drain. This was an indirect confirmation of the presence of a left solitary kidney.

At the above operation only a single ureter could be seen. Only the lower pole of the left kidney could be felt, but it was in its normal location.

The patient made an uneventful recovery. At subsequent examinations the absence of a right ureteral orifice and the failure to excrete indigocarmin on this side again noted. The cause of the hæmaturia during the five months preceding the anuria and the latter as well, were deemed to be due to a stricture in the pelvic ureter. In all probability this was secondary to a tonsillar infection. No attempt has been made at urography. The stricture is being dilated at intervals. At the last sitting (November 19, 1923) a No. 7 ureteral bougie after meeting with slight resistance could be passed to the kidney, but a No. 8 bougie could only be inserted for a distance of 15 cm. A mild infection due to *B. coli* has necessitated lavage of the left kidney pelvis upon two occasions.

In the accompanying tables, I have collected all of the published cases of true congenital solitary or single kidney, which have either been operated or in which an anuria has been relieved by non-operative measures. All reports in which there was no proof that a solitary kidney had been present were eliminated.

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TABLE I—*Operated or Catheterized Cases without Anuria* There were eleven cases It is of interest to note that in six of these only one ureteral orifice was found In one case (Suter) the opposite ureter was patent for one-half cm In another (Cohn) there were two normally placed orifices but no efflux from one of these In two, cystoscopy was not done on account of bladder intolerance The treatment in these cases varied from catheter drainage (Bugbee and Losce) to pyelotomy and nephrotomy In one case (Schultz) only an exploratory was performed

TABLE II—*Cases of Anuria in Solitary Kidney* This embraces 16 cases including our own The duration of the anuria is only mentioned in nine cases It

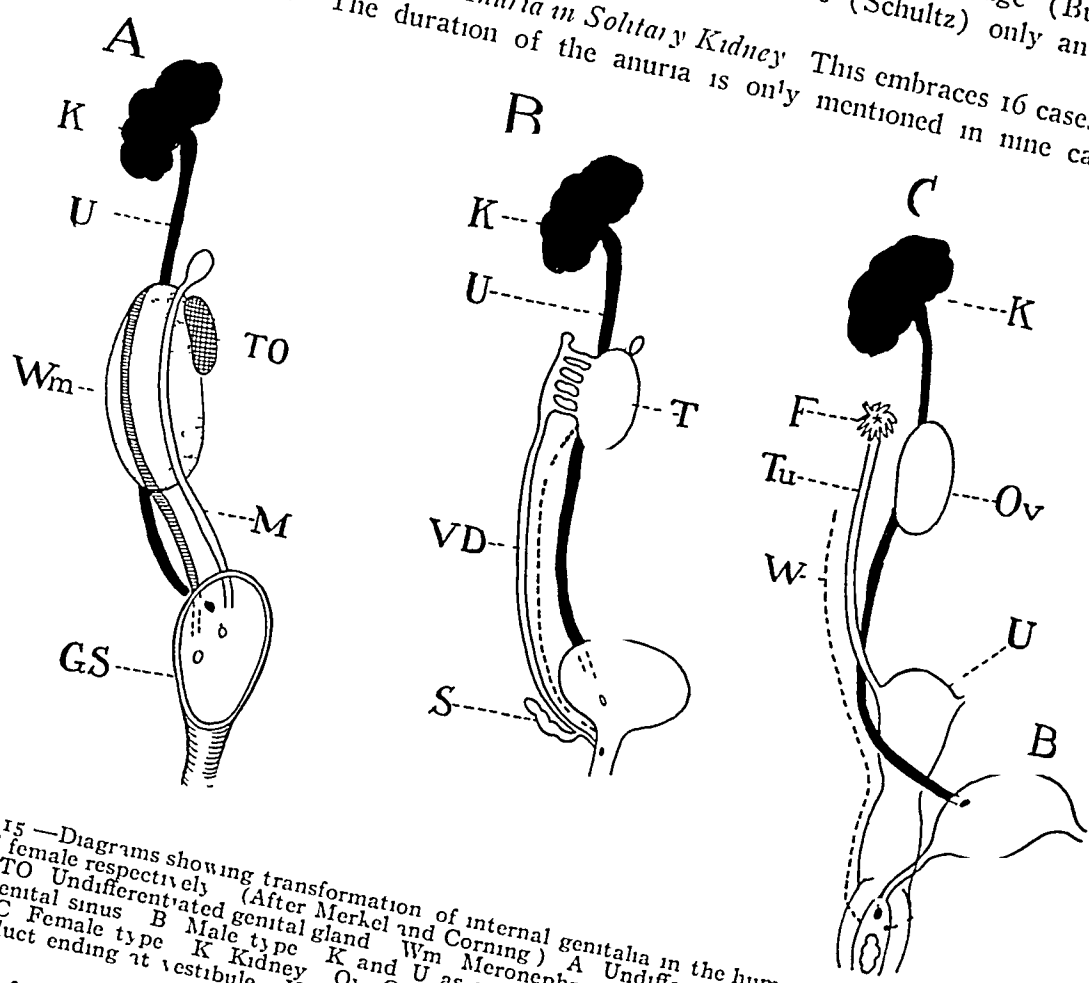


FIG 15—Diagrams showing transformation of internal genitalia in the human embryo into those of male and female respectively (After Merkel and Corning) A Undifferentiated stage K Kidney U Ureter TO Urogenital sinus B Male type Wm Meronephros (primitive kidney) M Mullerian duct GS Vesicle C Female type K Kidney O Ovary F Fimbriated end of tube (Tu) W Obliterated Wolffian duct ending at vestibule U Uterus B Bladder

varied from twenty hours (Castano) to nine days (Wyss and Kronlem), indicating, as is well known, that the period of tolerance is sufficiently prolonged to justify attempts to relieve the anuria during the first three or four days by ureteral catheterization alone No attempt was made to relieve the anuria in the case in which it lasted nine days (Wyss and Kronlem) Ureteral catheterization was employed in seven cases (Heitz-Boyer and Heyman, but in three cases because of Krebs, Andre Gorach and Heyman, but in three cases because the anuria recurred after withdrawal of the ureteral catheter Eight cases were operated primarily Six of these died shortly after operation One died six years after the first operation and in one case the prognosis was considered very bad The four cases treated by ureteral catheterization alone all recovered while in the three which required later operations there was one death and two recoveries (Castano and our own) In the fatal case of anuria (Heitz-Boyer and

Eliot), treated by primary ureteral catheterization and later operation, death was due to bronchopneumonia after four weeks. At autopsy a calculus was found blocking up the left single ureter. If ureterotomy had been performed in this case instead of nephrostomy, the chances for recovery would have been better.

A comparison of the results of those treated primarily by operative measures with those in which the anuria was permanently or temporarily relieved by ureteral catheterization speaks for the advantages of the latter method of treatment. In only eight of the sixteen cases in this second table was a

diagnosis of probable anuria in solitary kidney made before operation or other treatment. Three of these were reported in 1905, 1910 and 1911, respectively while the other five appear in the literature since 1917, four during the past two years. This shows that the clinical importance of a knowledge of the existence of congenital anomalies of the upper urinary tract is beginning to be better appreciated.

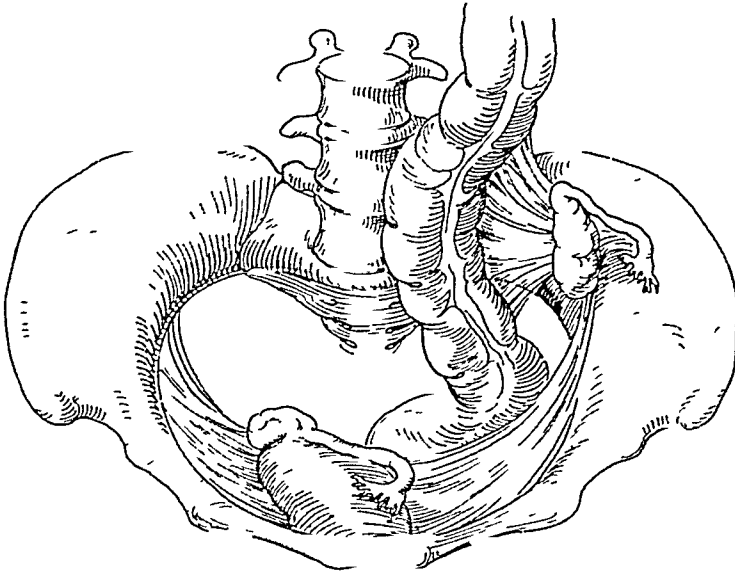


FIG 16—Solitary kidney and genital defects. Autopsy findings in girl of eighteen. Absence of left kidney adrenal ureter and blood vessels. Right single horned uterus. Rudimentary left horn. Left tube and ovary in iliac fossa close to pelvic inlet (Hoenigsberg).

TABLE III—*Cases in Which Nephrectomy was Performed*. This is only of historical value and should not be judged too harshly, inasmuch as the present more or less routine urologic study of an abdominal case was seldom carried out. It impresses one, however, even at the present day with the fact that the possible existence of a single kidney should be constantly borne in mind by the gynecologist as well as the general surgeon.

Diagnosis and Treatment The recognition of the presence of a single kidney depends chiefly upon the cystoscopic examination. As was stated above, the trigone may be symmetric or asymmetric. If the latter condition exists, the attention of the examiner would be attracted at once, but if the trigone is perfectly symmetric and especially if a normal appearing ureteral orifice presents at the normal location of such an orifice on the side opposite to that of the solitary kidney, one could easily be led astray. This would be especially true of cases where a rudimentary ureter is present on the opposite side and is patent as has been the case in a number of reports, for variable distances. If a ureteral orifice is not found at the normal location the first duty of the cystoscopist is to look in other portions of the bladder and even

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in the posterior urethra for the abnormal ending of a ureter. In addition to extravescical openings in the urethra one must bear in mind the possibility in the female of such an opening in the vestibule, anterior wall of the vagina, or in



FIG 17 —Hydronephrotic median solitary kidney with bicornuate uterus (R. Keller)

a submucous cyst. One of the most valuable aids is the injection of indigo-carmin, the excretion of which will aid in locating the missing orifice. In cases suspected to be congenital single kidney and not presenting the symptoms of anuria, urography will also be of great aid. The same is true of radiograms

with X-ray catheters *in situ*. Even in the presence of anuria of not more than four days' duration, search should be made at once for the presence or absence of a second ureteral orifice. The diagnosis of anuria in an individual possessing congenitally only one kidney presents no features which distinguish it from that of anuria in general, except perhaps the tendency to recurrence of the symptoms unless the obstruction is overcome. Of great value perhaps in the future will be the observation of the size of the kidney shadow in the roentgenogram and the fact that it is only present on one side, as is true of our case. The size alone is not a criterion unless it is very large, because the kidney in a certain proportion of cases is approximately normal in size.

The treatment of cases which do not present the symptoms of anuria differs in general but little from the methods which one would employ in the case of a person having two kidneys. The tendency should be towards the most conservative measures. The treatment of cases with symptoms of anuria should be equally conservative in the beginning. Ureteral catheterization should be employed as early as possible. As soon as the crisis is over operative measures such as ureterotomy or pyelotomy should be considered. If, however, the anuria recurs as it did in our own case, it may be necessary to operate earlier. I do not consider the operative measures should be employed, however, until ureteral catheterization has been given a fair trial. The patient is a far better risk for an operation to deliver a calculus or drain a kidney after the retention products incident to the anuria have been eliminated from the blood and tissues. One cannot depend upon any average period of tolerance, hence early diagnosis and ureteral catheterization must be the key to success in the future.

REFERENCES

- ¹ Donald Brown J Anat and Phys, vol XLVIII, p 196 1894
- Henry Morris Surg Dis Kidneys, 1901
- ² Guizzetti and Pariset Virch Arch vol CCIV, p 372, 1911
- ³ Nauman Inaug Thesis-Kiel, 1897
- ⁴ Sangalli Proc Lombard Inst Sciences, vol IX p 488, 1876
- ⁵ Rootes Lancet, vol II, p 251, 1866
- ⁶ Reinfelder Inaug Thesis, March, 1895
- ⁷ Motzfeld Zieg Beitr, vol LIX, p 39, 1914
- ⁸ Ballowitz Virch Arch, vol CXI, p 309, 1895
- ⁹ Engel Zieg Beitr, vol LXXII, p 549, 1920
- ¹⁰ Anders Am J Med Sci, March, 1910, vol CXXXIX, p 313
- ¹¹ M W Lyon, Jr Proc Assoc Isthmian Canal Zone, vol IX, p 80, 1917
- ¹² Papin Encycl Franc d'Vol, vol III, p 246, 1914
- ¹³ Winter Arch klin Chir, vol LXIX, p 611, 1903
- ¹⁴ Lyon-Caen and Marnier Bull Soc Anat, May, 1907, vol IX, p 400
- ¹⁵ Horand *Idem*, April, 1905, vol VII, p 307
- ¹⁶ Forster, quoted by Schwartz
- ¹⁷ Schultz Beitr klin Chir, vol III, Heft I, 1917
- ¹⁸ Erhardt Schmidt Ziegler's Beitrage, vol XLII, p 516, 1907
- ¹⁹ Desider Engel *Idem*, vol LXVII, p 549, 1920
- ²⁰ Wm Weibel Monatsch f Geb u Gynack, vol XXXI, p 197, 1910
- ²¹ Hepburn ANNALS OF SURGERY, vol LXXVIII, p 294, 1918
- ²² Eismayer Zeit f Urol Chir, Jan, 1923, vol VI, p 191
- ²³ Bolaffio Zeit f Geb u Gyn, 68, Heft 2, 1911

Operated or Catheterized Cases of Single Kidney without Anuria			
No	Reported by	Pre-operative findings	Treatment
1	Verhoogen (quoted by Winter)	Female with disturbances of urination for 3 years Cystoscopy not done on account of bladder intolerance Urine contained intolerable bacilli Right kidney enlarged	Nephrotomy (right)
2	Thelen Zeit f Urol, vol 11, p 145, 1908	Pyuria and pain over right kidney Cystoscopy revealed pus escaping from right ureteral orifice No left orifice visible and no indigocarmine from this side of bladder	Removed large calculus from pelvis of right kidney Failed to find opposite (left) kidney upon exposing this side
3	II Kummell Berl Kl Woch, Apr 19, 1909, vol 11, p 718	Male 45 Sudden onset hæmaturia and of large right abdominal tumor Cystoscopy revealed absence of left ureteral orifice Bloody urine from right kidney Large shadow of calculus shadow, none of left Small mission Symptoms of uremia on admission	Pyelotomy Small calculus removed from right renal pelvis
4	F R Hagner J A M A, Oct 30, 1909, vol 11, p 1181	Female 40 History of recurrent left colics with passage of calculi Cystoscopy revealed absence of right ureteral orifice Opposite (left) orifice gaped and turbid fluid escaped	At operation found left pyonephrosis
5	Suter Handbuch d Inn Med, vol 11, Part 2, p 1743	Male 24 Diagnosis of calculous hydronephrosis of congenital single kidney made before operation Left ureter patent for one-half cm, but no function Stricture in opposite (right) ureter at ureteropelvic junction	Nephrotomy
			Death from nephritis of right single kidney No left kidney found at autopsy
			Died 9 days after operation At autopsy no left kidney found
			All urine escaped from nephrotomy incision
			Recovery
			Died 24 hours after operation Absence of left kidney at autopsy

CONGENITAL SOLITARY KIDNEY

TABLE I —Continued
Operated or Catheterized Cases of Single Kidney without Anuria

No	Reported by	Pre operative findings	Treatment	Results
6	Bugbee and Losee Surg Gynec and Obst, Feb, 1919, vol xxviii, p 97	Female 20 Pain and mass right lower quadrant Cystoscopy revealed ab- sence of left ureteral orifice Pus and red cells from opposite (right) ureter	Catheter drainage followed by clearing up of the urine from right (single) kidney	Recovery
7	Bugbee and Losee Surg Gynec and Obst, Feb, 1919, vol xxviii, p 97	Female 33 History of hæmaturia and passage of two calculi Cystoscopy revealed absence of left ureteral ori- fice Diagnosis made of calculus ob- structing left uretero pelvic junction	Pyelotomy	Recovery
8	Schultz Beitr z Klin Chir, vol cui, p 1, 1918	Male 18 Sudden onset of pain and suprapubic tumor	Laparotomy revealed a large ex- trapertoneal tumor in true pel- vis found to be infected ectopic kidney	Died seven days after operation Autopsy revealed single kidney lying in true pelvis with ureter ending in median line of bladder
9	Theo Cohn Zeit f Urol Chir, vol v, p 1, 1920	Male 21 Trauma followed by right hydronephrosis Cystoscopy re- vealed two normally placed ureteral orifices but no efflux from left	Drainage of right hydronephrosis	Death ten days after operation Two normally placed ureteral orifices found at autopsy but left ureter ended blindly above Right hydronephrosis (trauma- tic)
10	Bretzner Monograph on Kidney Sur- gery Berlin, 1921	Female 44 History of recurrent hæma- turia Cystoscopy revealed absence of left ureteral orifice Pus and blood escaped from right ureteral catheter	At operation found right pyone- phrosis	Outcome not given
11	Venzner Zeit Urol Chir, vol vi, p 162, 1912	Male 42 Colicky (left) pains Urine turbid and at times bloody Unable to catheterize right ureter Obtained pus and red blood cells from left kidney Negative X-ray	Removal of calculus from pelvis of left kidney	Died of uremia about four weeks after operation Absence of right kidney at autopsy

TABLE II
Cases of Congenital Single Kidney with Anuria

No	Reported by	Previous history and findings	Treatment	Results
1	Springorum Munch Med Woch, vol viii, p 220, 1899	Anuria in case of right renal calculus	Nephrotomy	Death on day after operation Autopsy revealed large right ureteral calculus with impacted
2	Wyss and Kronlein Beitr z Klin Chr, vol xviii, p 54, 1901	Male 44 Two previous attacks of anuria lasting 4 to 6 days Seen on ninth day of anuria during third attack	Laparotomy revealed much en- larged left kidney Nothing done	Died two days after operation At autopsy found calculus blocking ureter of only (left) kidney
3	Krebs, Russki Wratsch No 18, 1903 Quoted by Owtschinnikow, Monats- bericht fur Urologie, vol i, p 63, 1905	Anuria (details not given) Cystos- copy revealed absence of right ure- teral orifice	Relieved anuria by catheteriza- tion of left ureter	Recovery
4	Schwartz Zent fur Chirurgie, 1905	Pain in left upper quadrant and anuria	Pyelotomy for calculus	Death from pyelonephritis No right kidney found at autopsy
5	Adrian Foka Urologica, vol viii, p 182, 1908	Male 37 Sudden onset of anuria and enlarged right kidney	Nephrotomy by Madelung Post- operative cystoscopy revealed only one ureteral orifice revealed later Ureterotomy one year escaped through ureteral fis- tula (right)	Died of urosepsis six years after second operation Autopsy re- vealed calculus pyonephrosis renal pelvis Absence of left kidney, ureter close to ing half of trigone and correspond- No genital defects
6	Heitz-Boyer and Eliot Bull Soc Anat, vol lxxiv, p 123, 1910	Male 27 Anuria for 6 days Cystos- copy revealed absence of right ure- teral orifice Opposite (left) orifice normal	Left ureteral catheterization re- lieved anuria Recurrence of anuria on eleventh day relieved by nephrotomy	Death from bronchopneumonia 4 weeks later At autopsy left (single) kidney found double the normal size No right kidney Small calculus completely ob- structed left ureter

CONGENITAL SOLITARY KIDNEY

TABLE II—Continued
Cases of Congenital Single Kidney with Anuria

No	Reported by	Previous history and findings	Treatment	Results
7	André Ann mal org g u, Jan 1911, vol xxix, p 132	Male 42 Anuria of 48 hours duration Left-sided colics for 6 yrs Bladder empty on admission Cystoscopy failed to reveal presence of right ure- teral orifice Negative X-ray	Anuria relieved by left ureteral catheterization	Recovery Obstruction thought to be due to small impacted ure- teral calculus
8	Tixer and Gautier Ann mal des org g u, vol xxix, p 722, 1911	Female 20 Entered comatose after 4 days anuria with large left abdom- inal tumor No urine found in blad- der and none obtained on catheter- ization of right ureter	Drainage of hydronephrotic left kidney All urine at first through fistula, later some per urethram	Recovery but prognosis consid- ered very bad
9	P Bazy Jour d'Urologie, vol ii, p 645, 1912	Male 71 Anuria of 7 days duration, preceded by left lumbar pain Eme- sis since onset X-ray shadow in pelvic portion of ureter	Ureterotomy but no calculus found	All urine passed through fistula none from bladder Recovery
10	Gorach, quoted by Papin, Encycl France d' Urol, vol iii, p 253, 1914	No details given before treatment was given	Relieved three attacks of anuria by ureteral catheterization in case of congenital single kidney	Recovery
11	Suter Handbuch d Inn Med, vol iii, Part 2, 1743	Symptoms of calculous anuria of soli- tary kidney	Nephrotomy	Death No mention of an autopsy
12	Castano Rivist assoc med Argen- tina, vol xxvii, p 423, 1917	Male 50 History severe colics (left) Anuria for 20 hours before admis- sion No urine in bladder Cysto- scopy revealed absence of right ure- teral orifice Opposite (left) orifice gaping and swollen	Relieved anuria by left ureteral catheterization but obliged to perform pyelotomy when anuria recurred after withdrawal of catheter No urine per ureth- ram until pyelotomy healed Later small calculus passed spontaneously	Recovery

13	Briggs Urol & Cutan Rev, April, 1921, vol xxv, p 210	Anuria of 24 hours duration accom- panied by pains over right kidney, chills and fever History of similar attack four weeks previously Large shadow over right kidney area Right ureteral orifice but no efflux on catheterization No left orifice visible	Pyelotomy (right) Tubercles seen on surface of kidney	No urine passed after pyelotomy Died on sixth day after opera- tion Failed to find left kidney or ureter at autopsy Only allowed to examine this side
14	Arnold Heymann Zeit f Urol Chr, vol ix, p 193, 1923	Female 35 Anuria of five days dura- tion No urine found in bladder Cystoscopy revealed absence of in- ter-ureteric ligament and of left uret- eral orifice No indigocarmine ex- creted from left side of bladder	Right ureteral catheterization re- lieved anuria Believes obstruc- tion to have been antiospastic Pyelography after operation re- vealed normal sized pelvis on right side	Recovery
15	Eisendrath and Wright	Male 49 Anuria 24 hours duration Left-sided colics Cystoscopy and use of indigocarmine during three ex- aminations failed to reveal presence of right ureteral orifice Large left kidney shadow, none on right side No calculus shadows	Anuria relieved by left ureteral catheterization Recurrence of anuria after withdrawal of cath- eter Ureterostomy Cause of obstruction found to be stric- ture of pelvic portion of left ureter	Recovery
16	Key Nord med Arkiv, vol xli, p 1, 1921	Sudden onset of anuria Only right ureteral orifice present	Anuria relieved by nephrotomy Ureteral calculus removed later, followed by fistula (renal) from which urine suddenly ceased to escape	Death due to pyelonephritis of solitary kidney complicated by stricture of the ureter

TABLE III
Cases of Congenital Single Kidney in which Nephrectomy was Performed

No	Reported by	Pre-operative findings	Treatment	Results
1	Guinard Arch gen chir ?, p 315, 1911	Symptoms of severe renal infection with calculi	Nephrectomy	Autopsy revealed the absence of opposite kidney and of the cor- responding internal genitalia
2	Polk, quoted by Schultz	Female 19 Large tumor in left iliac fossa	Removal of tumor (left single kidney)	Death eleven days after operation Autopsy revealed absence of in- ternal genitalia and of right kidney
3	Schetelg, quoted by Winter	No details given	Nephrectomy of single (congeni- tal) kidney	Death
4	Buss Zeit 1 Klin Med, vol xxviii, p 439, 1899	Left-sided tumor in true pelvis thought to be enlarged ovary	Removal of tumor which proved to be a kidney	Death seven days after opera- tion No right kidney or inter- nal genitalia found at autopsy
5	Winter Arch f Klin Chr, vol lxix, p 611, 1903	Male 21 Sudden onset Large right abdominal tumor No cystoscopy	Exploratory operation revealed large cystic kidney Nephrec- tomy	Death five days after operation Autopsy revealed a left ureter 8 cm ending normally below but blindly above Left kidney ab- sent
6	Guteras St Louis M & S J, vol lxxiv, p 129, 1903	Male 21 Symptoms acute left renal infection Diagnosis of renal tuber- culosis made	Removed left kidney containing multiple abscesses	Died eight days after operation No right kidney found at au- topsy

PYLORECTOMY FOLLOWED BY KOCHER'S METHOD OF GASTRODUODENOSTOMY IN CERTAIN CASES OF CARCINOMA OF THE STOMACH

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THEODOR KOCHER, Professor of Surgery in the University of Bern, Switzerland, describes in his text-book on Operative Surgery published in 1903, his method of anastomosing the duodenum to the posterior wall of the stomach after pylorectomy or partial gastrectomy. It is known in surgical literature as Kocher's method of gastrectomy, in contrast to Billroth I, Billroth II, and Polya's operation.

For reasons unknown to me this method is rarely employed in this country or abroad, except in Kocher's Clinic.

Doctor Bloodgood's attention to this method was attracted when Dr M Hartwig sent him in 1900, a specimen resected in 1895. This specimen and its photograph are still in the Laboratory. On section it is a distinct carcinoma well circumscribed. This patient lived in comfort and died seven years after operation of an abscess of the kidney. It is the first recorded five-year cure of cancer of the stomach in the Surgical Pathological Laboratory of the Johns Hopkins Hospital.

Not until 1910, did Doctor Bloodgood have the opportunity to apply this method of anastomosis after pylorectomy or partial gastrectomy, because the extent of the ulcer or cancer made the area of stomach removed, too large to permit the suture of the duodenum to the stomach without tension.

The first gastrectomy of the Kocher type was performed in St Agnes' Hospital, in August, 1910, more than thirteen years ago. The tumor was a freely movable mass at the pylorus producing almost complete obstruction, and the patient was starving to death. The operation was performed under local anæsthesia. Microscopically, the tumor proved to be a carcinoma (Figs 4 and 5). This patient, now aged sixty-eight is free from recurrence and in good health.

After reading the original description of twenty-six operations of this type, all but four of which were performed by Doctor Bloodgood, I would describe the technic as follows:

The abdomen is opened under novocaine in the midline above the umbilicus. In many of the cases gas, gas-ether, or light ether were given for the deeper manipulations. The stomach, duodenum, pancreas, glands along the lesser and greater curvature are carefully palpated and inspected.

With rare exceptions the following has been the rule as to the indication for resection. If the palpable mass gives the impression that it can be resected

with a good margin without or very little injury to the pancreas, and for this reason offers the probability of a cure should it prove to be cancer, resection is undertaken. If adhesions to the pancreas, or liver, or too extensive involvement of glands clearly portray a local condition which, if malignant, would not be cured by resection, some form of gastro-enterostomy is performed.

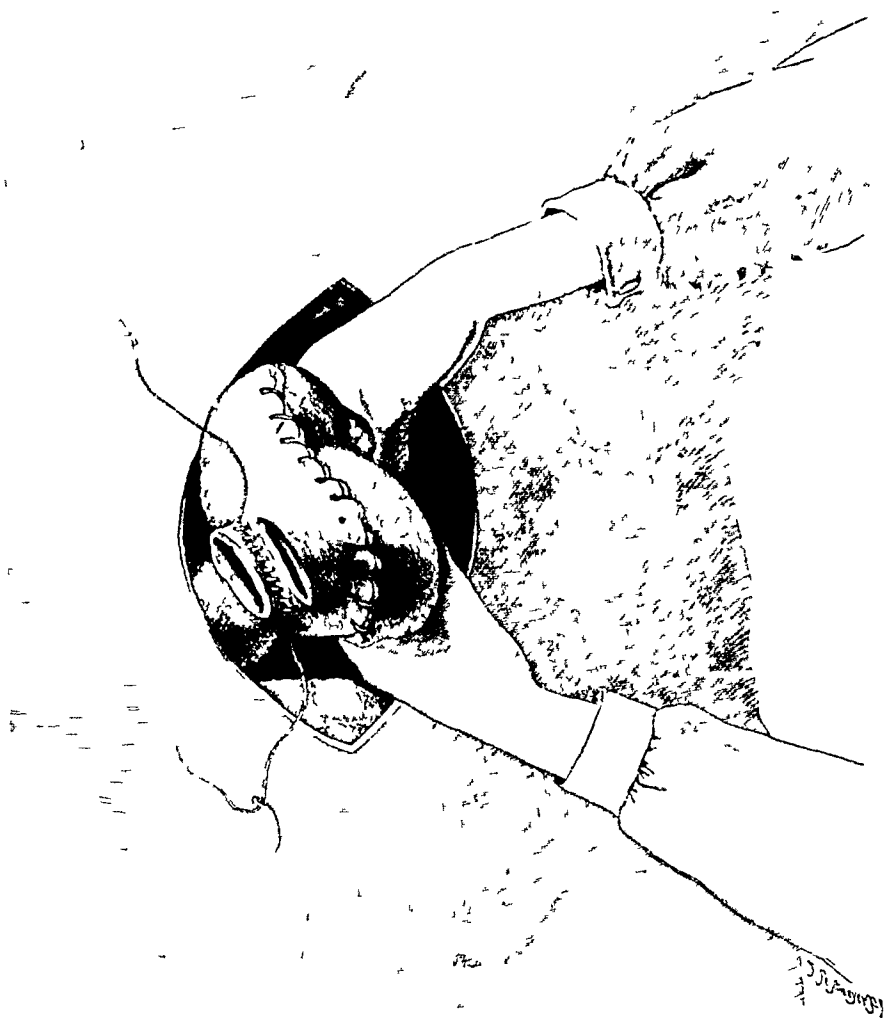


FIG 1—Kocher's method of anastomosis after pylororectomy (From Kocher's book on Operative Surgery)

The experience that has been gained in these two clinics and in reading the literature has quickly shown that attempts at resection of local lesions, too extensive to offer a probability of a cure, when the lesion is malignant, simply increase the mortality of the operation and prevent permanent cures in extensive lesions which are benign ulcers.

This impresses me as the most practical view as to operative indications.

One cannot tell until resection is partially completed what the method of anastomosis will be. It has been Doctor Bloodgood's rule to choose

PYLORECTOMY FOLLOWED BY GASTRODUODENOSTOMY

Kocher's method if the duodenum can be sutured to the posterior wall of the stomach without tension

The first procedure is to find the point on the greater curvature of the stomach where resection will ultimately be made. The vessel along the greater curvature is divided between ligatures. Irrespective of whether

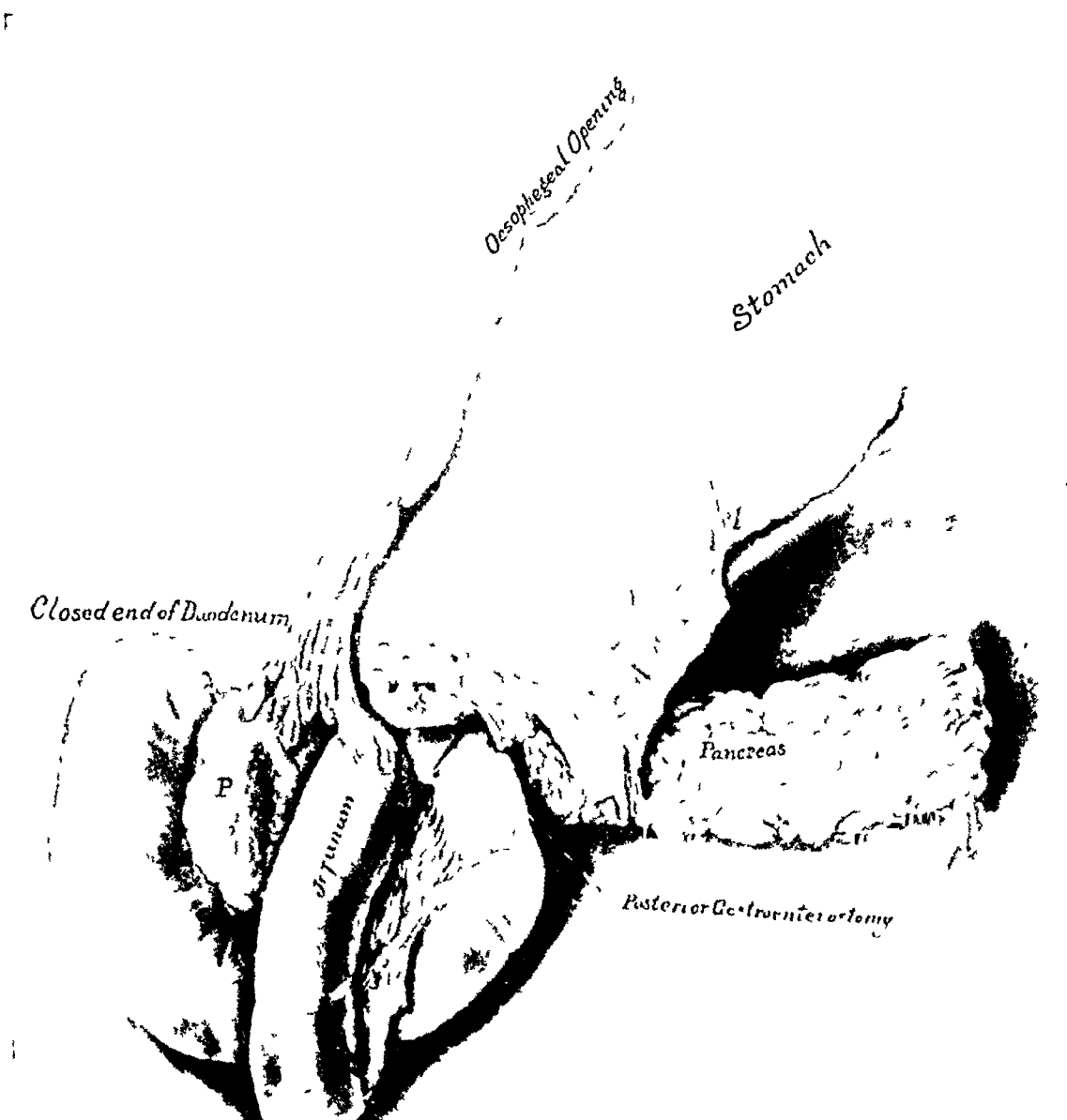


FIG 2—Photograph of autopsy specimen three months after pylorectomy for cancer with short-loop posterior gastro-enterostomy (Billroth II). Although it did not occur in this case, the illustration shows how a kink at X could produce acute dilatation of the duodenum (Pathol No 9871)

glands can be seen or felt along the greater curvature, the gland-bearing area is left with the stomach, and the vessels in the omentum and the gastrocolic ligament are ligated at as great a distance as possible from the stomach without injury to the colon or the middle colic artery. The stomach is therefore freed from the colon and omentum so that the operator can sweep his hand beneath the stomach and estimate the relations to the pancreas. Should this examination reveal adhesions more extensive than previously found, resection can be discontinued and some type of gastro-enterostomy performed.

The next most important step is to ligate the vessels on the duodenum and separate the stomach, pylorus and duodenum from the pancreas. The stomach is now separated except at its lesser curvature and the superior border of the duodenum. It is simpler to ligate the vessels on the upper



FIG 3—X-ray of stump immediately after bismuth meal of a patient whose stomach was resected with Kocher's anastomosis ten years before this X-ray was made. The anastomosis of the duodenum to the stomach is clearly shown. (Pathol No 12058)

tissue are separated from the lesser curvature of the stomach almost up to the diaphragm, just as one would remove the glands and tissue from the axillary vein. This never interferes with the circulation of the stomach, allows complete removal of the gland-bearing area on the lesser curvature side without removing uninvolved stomach wall.

It is a well-known and fundamentally established fact that the smaller the portion of the cardiac end of the stomach left after resection, the greater the difficulty of anastomosis and the greater the likelihood of increased mortality.

The stomach having been freed, the operator tests whether the duodenum

border of the duodenum and pylorus, clamp the duodenum and pylorus, and divide with the knife or scissors, not with the cautery. The guarded clamp on the duodenum is placed lightly so as not to interfere with circulation. Often it is removed and a sponge placed over the opening of the duodenum. The stomach is now lifted outwards and downwards to the left, and the vessels of the lesser curvature ligated as far as possible from the stomach. Having reached the point where the lesser curvature is to be divided, the remaining vessels and gland-bearing tis-

PYLORECTOMY FOLLOWED BY GASTRODUODENOSTOMY

can be sutured to the posterior wall without tension. If so, Kocher's method is chosen.

The anastomosis is a typical end-lateral. The method in this clinic is three rows of interrupted fine black silk sutures. The first row approximates the peritoneum of the duodenum to that of the stomach. Then the wall of the stomach is divided down to the mucous membrane and the second row introduced, catching the vessels in the stomach wall. The mucous membrane of the stomach is divided and sutured to that of the duodenum all the way around. There is no objection to using catgut in the mucous membrane,



FIG. 4.—Photograph of resected pylorus, with portion of stomach and duodenum. Operation performed thirteen years ago. Patient well (1923). Anastomosis Kocher's type. For gross picture and photomicrograph see Figs. 5 and 6. (Pathol. No. 10763)

but in this clinic we have had no difficulty with the three rows of fine silk. The anastomosis completed, the stomach is divided without clamps and closed with three rows of fine silk. Now and then the suture is covered with omentum. Sometimes the transverse colon is fixed so it will not drop down. The abdominal wound is closed in the usual way.

Post-operative Treatment. These patients are always given subcutaneous salt solution and salt per rectum until they are taking sufficient fluid by mouth. Gastric lavage is made the night of operation and the next morning, after washing out the stomach an ounce of castor oil is introduced. This gastric lavage should be continued as long as there are duodenal contents in the stomach, but rarely is it necessary after the first twenty-four hours when the Kocher anastomosis is made.

These patients are not given solid food for at least two weeks, nor are they allowed to swallow grapes or the peel of baked apple. In an anastomosis

of this kind the lumen is partially closed by the necessary inversion and the inevitable inflammatory reaction. Solid food could easily obstruct, add to the discomfort, and might even be dangerous.

Mortality Among the 22 operations performed by Doctor Bloodgood, there are four deaths—a mortality of 18 per cent. The deaths occurred between 48 hours and 10 days, suggesting some type of embolism. There

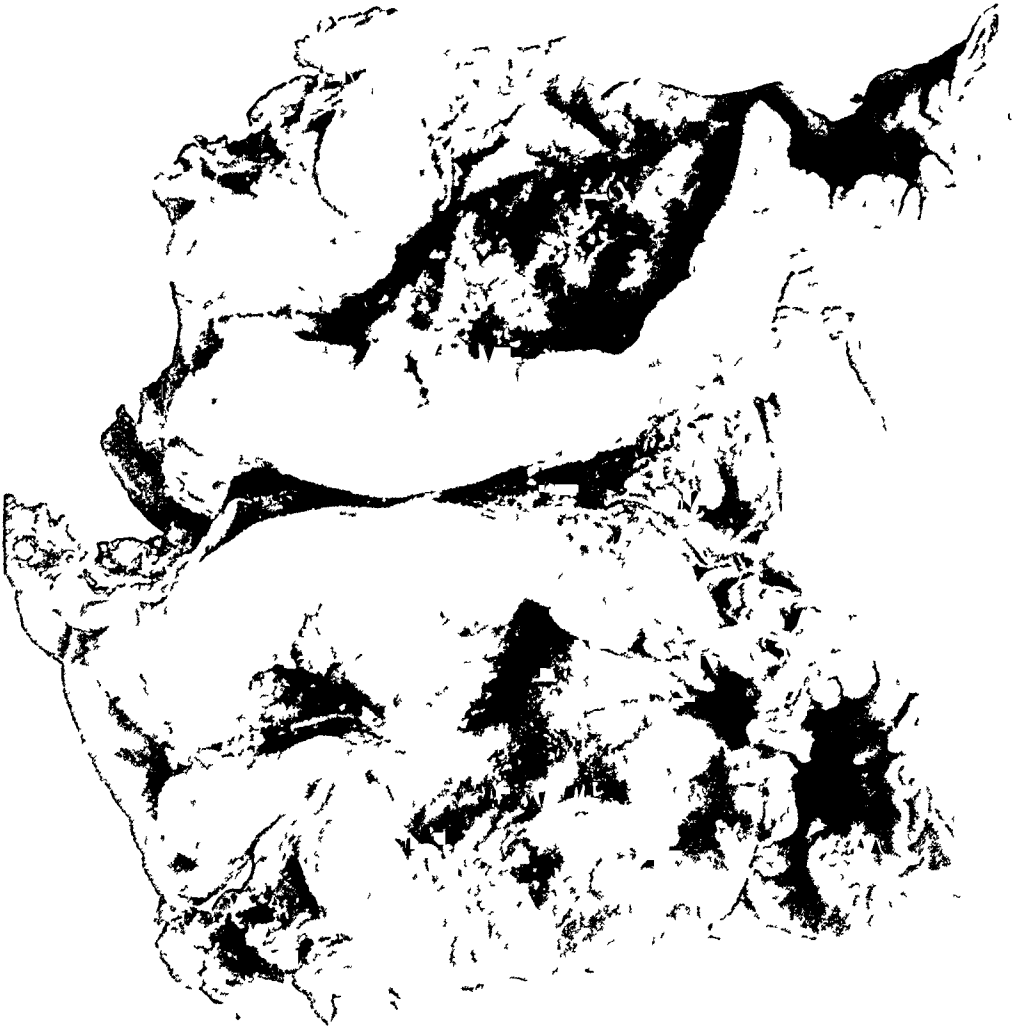


FIG 5—Photograph of opened stomach shown in Fig 4. Note the white area of neoplastic growth infiltrating to but not through the duodenum and not through the peritoneum. Glands not involved. Well thirteen years after resection (Pathol No 10763). For photomicrograph see Fig 6.

was not a single example of peritonitis or other complications on part of the intestinal suture. Of the remaining 4 cases by three other operators there were two deaths, one of them from peritonitis. So that among the 26 operations by this method there is but one faulty suture.

The age and sex, and condition of this small group corresponded closely with that in the larger group of cancer and ulcer. They were neither better nor worse operative risks, but they were subjected to an operation of less extent than by any other method, except the Billroth I.

PYLORECTOMY FOLLOWED BY GASTRODUODENOSTOMY

Of the 12 patients with carcinoma, 3 are living 13 years and 4 years, respectively, since operation, and one lived 7 years and died of other cause. Therefore, of the 8 cases with cancer in which it is five years or more since operation, 3 patients, or 32 per cent, have passed the five-year period. But it is to be remembered that these carcinomas were of the most favorable type, and answered Kocher's rule, which was "The great majority of his

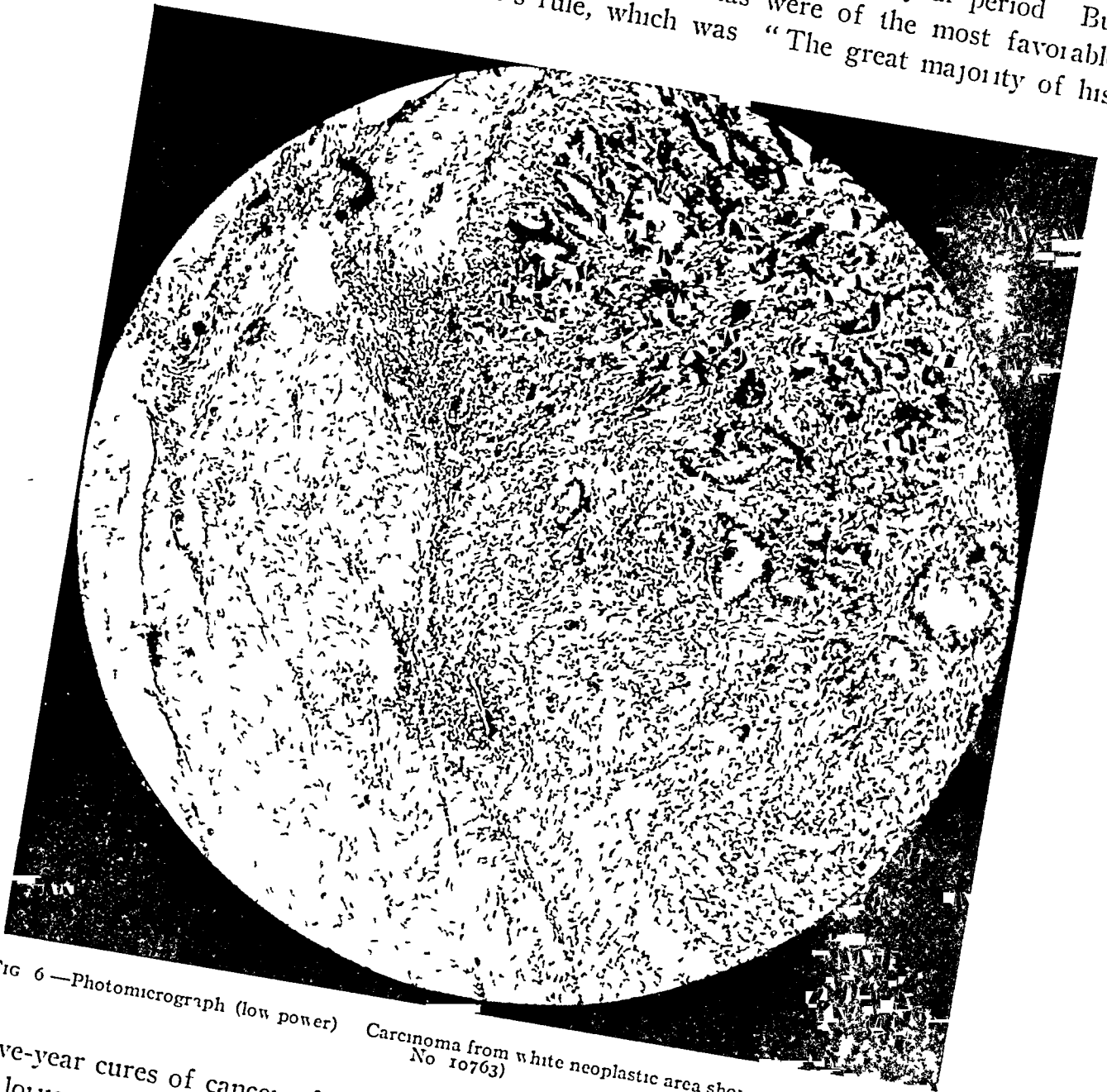


FIG 6 —Photomicrograph (low power) Carcinoma from white neoplastic area shown in Fig 5 (Patrol No 10763)

five-year cures of cancer of the stomach were freely movable nodules at the pylorus, producing early obstruction "

REMARKS BY DOCTOR BLOODGOOD

Since 1900, at frequent intervals I have restudied the gastric material in the Surgical Pathological Laboratory of the Johns Hopkins Hospital. This includes the records of all the patients in the Surgical Service of Johns Hopkins and of St Agnes' Hospital and for many years from the Surgical

Service of the Union Protestant Hospital We have carefully checked the immediate mortality and studied the ultimate function of the stomach

The thing which impressed me most was that if the patient survived the operation the ultimate function of the stomach was about the same, irrespective

of the type of anastomosis or resection It is important to remember that our gastric material as compared with some other clinics in this country and abroad is comparatively small, but I think it has been studied as carefully as in any clinic I have taken X-rays and made fluoroscope examinations, had gastric analyses made, and recorded the digestive



FIG 7 —X-ray before operation showing the filling defect due to a carcinoma at the pylorus (Pathol No 32468) For gross specimen see Figs 8 and 9

functions of patients of the following groups more than ten years after operation Billroth I, Billroth II, Kocher, Finney's pyloroplasty, different types of posterior gastro-enterostomy, anterior gastro-enterostomy and the long-loop Roux or "Y" No difference could be made out The choice of the operation, therefore, does not depend upon the ultimate function, but upon the study of the immediate mortality and complications

One must remember that the different types of resection of the stomach, or the different types of gastro-enterostomy are by no means always operations of choice—usually operations of necessity

PYLORECTOMY FOLLOWED BY GASTRODUODENOSTOMY

Our evidence indicates that the Kocher resection has the least mortality and post-operative complications. Finney's pyloroplasty in properly selected cases has practically no mortality and no complications. The short-loop posterior gastro-enterostomy for duodenal ulcer has practically no mortality and very few complications.

The chief objection to any resection of the stomach, followed by closure of the duodenal end and some form of gastro-enterostomy, is that a kink or obstruction, even temporary, in the gastro-enterostomy leads to acute dilatation of the duodenum and a toxic duodenal death brought out years ago in experiments on animals by ^A Draper and reported by me (*Journal Amer Med Assoc*, July 13, 1912, vol lix, p 1117).

In my early study of the literature I was impressed by the numerous deaths between the second and the fifth day attributed to shock with recorded autopsies noting no peritonitis. Later, from a case or two of my own I learned that these deaths were due to dilatation of the duodenum.

The danger of kinking of the gastro-enterostomy is apparently greater in a short-loop posterior, or the short-loop "Y," and distinctly less in any long-loop gastro-enterostomy. That the majority of the clinics in this country and abroad have substituted the Polya with a long loop is an indication that they were having trouble with the so-called Billroth II with a short-loop posterior gastro-enterostomy.

My limited experience teaches me that Finney's pyloroplasty is preferable to any form of gastro-enterostomy if it can be done and when it is indicated. That Kocher's anastomosis after gastrectomy is the operation of choice. When the gastrectomy leaves a defect prohibiting a safe Kocher, the gastro-enterostomy should be done with a long loop, and it makes very little difference whether it is of the Polya type or not. The point is that the loop must be sufficiently long to practically eliminate the danger of a kink and death from acute dilatation of the duodenum.

I rarely use clamps in anastomosis or resection of the stomach. I have



FIG 8—Photograph of the anterior surface of the portion of the stomach removed in the case shown in Fig. 7 (Pathol No 32468). Duodenum to the left, mass of glands and fat on greater curvature below, glands and fat on lesser curvature. The portion between B and A has been dissected from the lesser curvature of that part of the stomach not removed. These glands are involved (see Fig 9) (Pathol No 32468).

never had peritonitis from soiling. The fundamental principle of any anastomosis between hollow viscera is good circulation, second, perfect suture, and there is but one test of intestinal anastomosis—peritonitis from perforation in the line of suture, or obstruction. My experience teaches me that soiling is an exaggerated danger, and that circulation of the tissues and perfect approximation by suture are the essential features. I prefer Billroth's original

method of three rows of single sutures with the finest silk as adopted by Halsted, and not a single or double row of mattress suture. The continuous suture with catgut or linen thread has only one advantage—it is more rapid. As I have never tried it, I can neither praise nor condemn it. The operator's immediate mortality and the cause of death in the line of suture should indicate to him whether his method of suture is the best.

The recent contributions by William Mayo (*Surg, Gyn and Obstet*, April, 1923, vol xxxvi, p 447) and Richard K Lewisohn (*ANNALS OF SURGERY*, October, 1923, vol lxxviii, p 507), indicate a tendency to return, if possible, to the Billroth I, the principle of which is identical with Kocher's. It has, however, an advantage that it might be accomplished without tension when the Kocher could not. The illustrations (Billroth I) in these two papers practically show the Kocher anastomosis and the trend



FIG 9—Longitudinal section through specimen shown in Fig 8. Note the cancerous gland in that portion of the tissue removed from the lesser curvature shown in Fig 8 between A and Y. Note the excavated ulcer surrounding the pylorus and breaking through the peritoneal coat above. Compare with the filling defect shown in the X-ray (Fig 7) (Pathol No 32468) and compare with Fig 5 in which the cancer has not broken through the peritoneal coat.

of modern surgery to return to the fundamental conceptions of gastrectomy as conceived by Billroth and Winawarter, the Billroth I if possible and if a Billroth II becomes an operation of necessity, then a long-loop gastro-enterostomy.

I have before me now Billroth's *Clinical Surgery* with his historical and epoch-making diagrams and illustrations, and years ago in my reviews in the *International Clinics* I have called attention to these principles.

I would suggest to my colleagues who may read this article to restudy their operative mortality in gastric surgery and estimate the element of faulty suture and acute dilatation of the duodenum.

CARCINOMA OF THE DUODENUM

By DENVER M. VICKERS, M.D.

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FROM THE SURGICAL CLINIC OF THE MARY MCCLELLAN HOSPITAL

NEOPLASTIC disease of the small intestine is generally admitted to be rare, in contradistinction to carcinoma of the stomach and colon. Cancer of the stomach is rated by Osler¹ to be second only to that of the female genitalia, in point of frequency, quoting 30,000 autopsies by Welsh. Carcinoma of the rectum is not infrequent and carcinoma of the colon, especially around the flexures and the cæcum, while less often observed, is not unusual. But carcinoma of the small gut is still one of the rarities of medicine, either clinically or at autopsy.

Brill² estimated cancer of the intestine, excluding the stomach, as occurring in 2.5 per cent of cancers found in hospital autopsies. Mayo's Clinic figures give 3 per cent, Jefferson⁴ estimates 3.1 per cent and Geiser⁵ 4 per cent. Forque and Chavin⁶ in collecting and tabulating 88,031 autopsies, report cancer 6847 times, or 8.2 per cent, of these 9.2 per cent, or 642, were intestinal, the large intestine being affected 613 times, or 94 per cent, of the intestinal cancers, and the small 39, or 6 per cent. Cancer of the small gut occurred, therefore in 0.5 per cent of all cancers, or 0.04 per cent of all autopsies. Other collected statistics from eight different authors⁷ give 888 cancers of the intestine, of which 798 were in the large intestine, or 90.1 per cent, and 91, or 9.9 per cent, in the small intestine, with 12 or 4.5 per cent, in the duodenum, or in these cases 0.34 per cent of all cancers occur in the duodenum.

For any given unit of length of small gut, the jejunum shows the greatest relative "immunity" to cancer. Aizner⁷ reports one case and Murray⁸ casually mentions another, but there are few others in the literature. Muller,⁹ in 5621 autopsies, found cancer of the jejunum and ileum in only three cases compared to 6 in the duodenum. Carcinoma of the ileum near or at the ileocaecal valve brings up the total proportion for the jejunoileum slightly above that for the duodenum. McGuire and Cornish,¹⁰ in 1920, tabulated 66 carcinoma of the duodenum from ten authors compared to 69 carcinoma of the jejunoileum, a ratio of 47.7 per cent to 53.2 per cent.

The average length of the duodenum according to Treves¹¹ is ten inches, of the whole small intestine 22 feet 6 inches, so that for any given unit of length the susceptibility of the jejunum to cancer is decidedly less than that of stomach, colon or even duodenum.

The incidence of carcinoma of the duodenum or the relative frequency of that diagnosis in hospital autopsies is estimated at 0.05 per cent or once in 2000, by McGuire and Cornish (nine authors total of 151,201 cases).

who quote the eighteen cases of Fenwick,¹² found in 19,518 autopsies at the London Hospital, giving an incidence in itself of 0.09 per cent. Forque and Chavin's⁶ more recent tabulation gives 0.034 per cent. It is to be recalled that these were all pathological reports rather than summaries of clinical material.

Of the duodenum itself, cancer is found most frequently in the middle portion, or peri-ampullary region. Fenwick gives 51 cases of which over half were in the second or descending or peri-ampullary region. Geiser reports 71.8 per cent and Rolleston¹³ 67 per cent of juxta-ampullary cancer. It is probable, however, that in a certain percentage of these cases the malignant

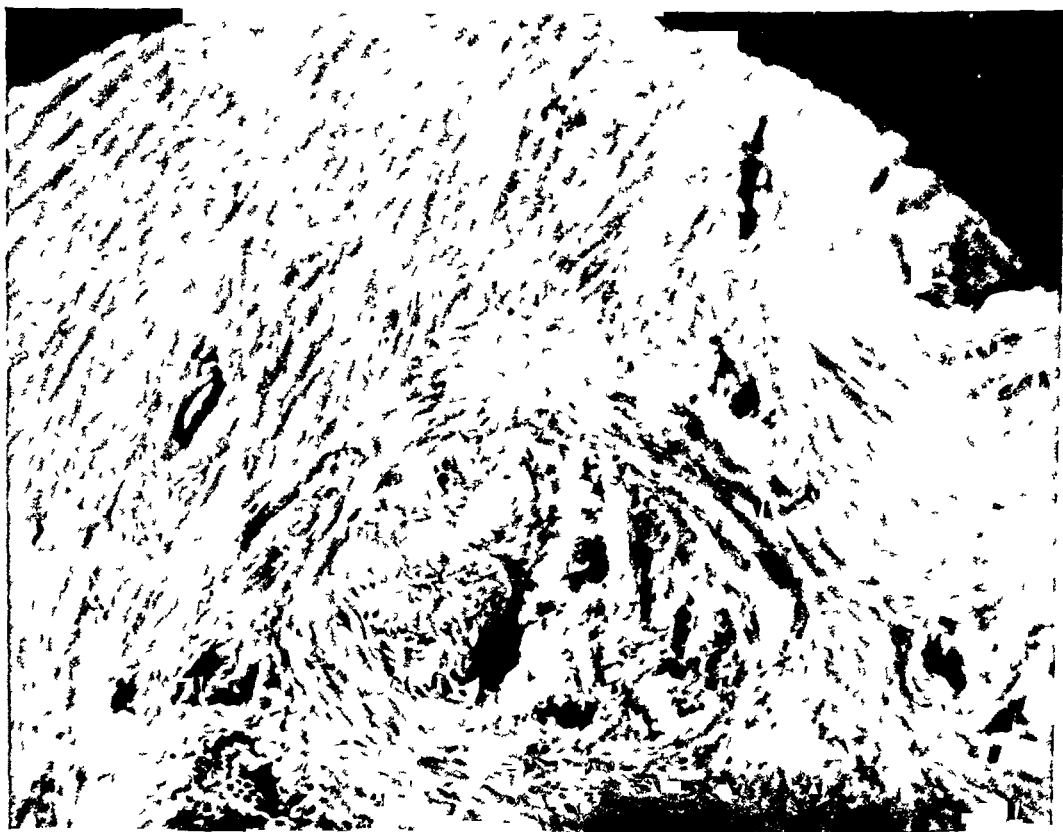


FIG. 1—Microphotograph of section taken from the tumor found in the case reported

growth arises in the common or pancreatic duct and only secondarily invaded the duodenum. The difficulty of exact diagnosis even at autopsy is obvious.

The incidence is next larger in the first portion and most uncommon in the third or juxtajejunal portion of the duodenum.

Mayo, in reporting three cases, found one in which the growth (in the first portion) seemed to be engrafted on a previously existing ulcer. Schrater, Ewald, Mackenzie, Leballo, and Letulle¹⁴ have also reported similar cases. But while this might happen in new growths in the first portion, ulcerations are notoriously infrequent in the portion distal to the ampulla, so that the new growth following a preexisting ulcer is decidedly unlikely. Lichy reports

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six cases of carcinoma of the first portion, none at the usual site for duodenal ulcer. Jefferson concludes that the relationship of duodenal cancer to ulcer "is difficult to establish."

Other factors give us no more clue as to the etiology of carcinoma in the duodenum than in new growths elsewhere. These patients are generally beyond middle age (fifty years, Pick) and the growth may follow irritation of the papilla by the change in reaction of the fluids, passage of gall-stones, etc., but no direct evidence is available. Why carcinoma is so frequent in the stomach and so rare in the duodenum, especially in the third portion, is one of the mysteries that may be cleared when we know more about the underlying causes of neoplasms.

Symptoms and signs due to duodenal malignancy vary markedly according to its location. Juxta-ampullary carcinoma makes known its presence mainly by obstruction to the flow of bile and pancreatic juice, with early jaundice, emaciation and death, and often cannot be differentiated from carcinoma of the head of the pancreas. Forgue and Chavin recognize the difficulty of accurate anatomical and pathological limitation of the ampulla, and classify the growth, whether intra- or peri-ampullary by the clinical picture, whether obstructive to the ducts or to the intestine, the "definition anatomo-clinique."

In cancer of the first or third portion, symptoms are of the digestive tract, anorexia, nausea and vomiting, constipation, diarrhoea and pain. In either supra- or infra-ampullary growths, the clinical picture may advance insidiously till it is difficult to distinguish from pyloric obstruction. In cases of infra-ampullary obstruction, the vomitus may contain bile and pancreatic ferments, which can be demonstrated by appropriate tests.

Physical examination in such cases reveals the dilated stomach, but rarely a palpable mass, as a growth large enough to obstruct, need not be large enough to be palpable through the abdominal wall. Metastases are usually late and small, and pelvic or rectal examination generally reveals no invasion of the "rectal shelf." Mayo¹⁶ states that one-half of all cases of intestinal cancer show no lymphatic involvement at autopsy.

The prognosis is variable. Cases are described with symptoms from two days to two years. Hirschel¹⁵ successfully resected the duodenum for ampullary cancer. Juxta-ampullary cancer is usually rapidly fatal and is an example of one area of the body, where a very small tumor can quickly produce extreme emaciation and death. Carcinoma above and below may go unrecognized till it produces almost total occlusion, with rapid change in symptomatology and clinical picture, with eventual death from starvation.

Treatment is of course, primarily surgical. The technical difficulties offer great odds to the performance of any radical operation. Gastro-enterostomy may prolong life in the obstructive cases and relieve symptoms for considerable periods, as these tumors are slow growing and metastasize late. Cholecystenterostomy or gastrocholecystostomy have been performed for obstruction of the ampulla with varying success. The eventual outcome is obvious.

DENVER M VICKERS

CASE REPORT—L P C, No 16290, entered the hospital, April 8, 1923, complaining of vomiting. He was a married man of sixty-four, with no living children and no family history of cancer. He had always been well and active, and for the past few years had been doing hard physical work on a farm. He had had no trouble with the stomach till the onset of the present illness. One month before admission he began to vomit. This gradually increased till during the week before entry, he regurgitated practically everything taken by mouth, raising large quantities, even up to quarts or more, once or twice a day. He had had only slight epigastric distress and no acute pain. He had lost about twenty pounds in the past month and with the exception of the vomiting, feels perfectly well.

Examination showed an emaciated, poorly nourished farmer of sixty-four, who walked into the hospital. The general physical examination was negative. The abdomen was distended, but showed no involuntary muscle spasm. There was slight tenderness in the epigastrium and the stomach could be outlined by percussion as a huge sac, with the lower border almost to the iliac crest. Gastric lavage removed approximately a gallon of sour, foul, partly digested stomach contents. X-ray with barium by mouth, showed a huge atonic stomach with the barium obstructed just beyond the pylorus. The diagnosis of pyloric obstruction was made and operation advised.

Exploratory laparotomy by Dr Chas G McMullen disclosed a huge stomach and dilated duodenum. The first and second portions of the duodenum were thin-walled, three times normal diameter, but showing no other abnormalities. Following along, a mass was palpated at the junction of the third portion of the duodenum with the jejunum. This mass was hard, indurated, fixed and clinically malignant. There were numerous small, pea-sized nodules scattered over the peritoneal surface of the intestine, the omentum and the colon. A quick posterior gastro-enterostomy was done and the incision closed. The radical operation was impossible.

For the first few weeks post-operative the patient did well. Soon, however, he began to vomit again, in spite of dietary restriction and frequent lavages. He began to go steadily down hill and finally after two months in the hospital he died.

Autopsy was obtained six hours post-mortem. The stomach was distended but not nearly to the extent seen at operation. In the third portion of the duodenum, where the duodenum turns about the ligament of Treitz and the superior mesenteric artery, there was a hard, firm, annular growth the size of a plum, adherent to the posterior abdominal wall. There were numerous small nodules, dotted over the peritoneal surfaces, about the size seen at operation. The primary mass was practically obstructing the lumen of the bowel, so that only a fine probe would pass. The growth had surrounded the superior mesenteric artery, so that the tumor removed for pathological study showed a section of the artery. The cut surface of the growth was hard, glistening and clinically cancer. Examination was otherwise essentially irrelevant, showing the changes characteristic of his age and nutrition.

Microscopical examination of the tumor mass showed much fibrous tissue, with rows or columns of epithelial cells, growing in acinous forms. The diagnosis of infiltrating carcinoma was confirmed by Doctor Ewing.

TABLE A

Carcinoma of Duodenum—Incidence

Author	Total autopsies	Incidence %
Perry-Shaw, ¹⁷ Guy's Hospital	17,652	0.050
Fenwick, ¹² London Hospital	19,518	0.090
McGuire, ²⁰ quoting nine authors	151,201	0.033.

CARCINOMA OF THE DUODENUM

TABLE B

Carcinoma of Duodenum—Distribution

Author	Portion			
	1st %	2nd %	3d %	Diffuse %
Fenwick ¹²	21	57	13	8
Geiser ⁵	15.5	71.8	12.7	
Rolleston ¹³	24	67	9	
Deaver ¹⁷	22.15	65.82	12.02	

SUMMARY

Carcinoma of the duodenum is clinically unusual and is found in 0.033 per cent to 0.09 per cent of hospital autopsies

Carcinoma is most frequent in the second, descending or periampullary portion. Next in order of frequency is the first portion, and last is the third or juxta-jejunal portion.

There are no significant facts in its site, age, distribution, preceding symptomatology to suggest an etiology, other than those of neoplasms elsewhere.

Symptoms follow from obstruction of the ducts in peri-ampullary cancer and from obstruction of the lumen of the gut in the infra- or supra-ampullary growths.

Treatment is primarily surgical and usually only palliative. Results in general are still unsatisfactory.

BIBLIOGRAPHY

- ¹ Osler. Principles and Practice of Medicine. Ed. VIII, Appleton, New York.
- ² Brill. Primary Carcinoma of Duodenum. Am Jour Med Sci, Nov. 1914, vol. cliv, p. 824.
- ³ Mayo. Carcinoma of the Intestine. ANNALS OF SURGERY, vol. lxxii, p. 316.
- ⁴ Jefferson. Cancer of the Suprapapillary Duodenum. Brit Jour of Surg, Oct., 1916.
- ⁵ Geiser. Ueber Duodenalkrebs. Deutsche Zeits. Chir., 1907, vol. lxxvi, p. 41.
- ⁶ Forque and Chavin. Le Cancer Primitif et Intrinsèque du Duodenum. Revue de Chir. 1915, vol. xlv, p. 470.
- ⁷ Aizner. Deutsche Zeitschrift f. Chir., Oct., 1909, vol. lxxvii, p. 413.
- ⁸ Murray. The Clinical Pathology of Pyloric Occlusion. Arch. of Surg., July, 1913, vol. vii, p. 178.
- ⁹ Muller. Beitrage zur Kenntniss des Metastasenbild. Malign. Tumoren. Berne, 1892.
- ¹⁰ McGuire and Cornish. Carcinoma of Duodenum. ANNALS OF SURGERY, Nov. 1920, vol. lxxii, p. 600.
- ¹¹ Treves. Quoted in Gray's Anatomy.
- ¹² Fenwick. Cancer and Other Tumors of the Stomach. London, 1902.
- ¹³ Rolleston. Carcinomatous Stricture of the Duodenum. Lancet 1901, vol. i, p. 1121.
- ¹⁴ Quoted by Forque and Chavin.⁶
- ¹⁵ Hirschel. Munch. Med. Woch., 1914, p. 1728.
- ¹⁶ Mayo. Jour. Am. Med. Assn., Oct. 19, 1901.
- ¹⁷ Perry and Shaw. On Diseases of Duodenum. Guy's Hospital Reports, 1893, vol. 1, p. 274.
- ¹⁸ Deaver and Ravdin. Amer. Jour. Med. Sci. 1920, vol. cliv, p. 469.

CHRONIC PRIMARY INTUSSUSCEPTION IN YOUNG CHILDREN

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ACUTE intussusception of the bowel is a disease of infancy and early childhood, chronic intussusception of adult life. The acute form of intussusception is usually of the primary type and the chronic form of the secondary type, or that in which the invagination is due to intestinal tumors, and so forth. The two children with chronic primary intussusception whose histories are presented in this paper were operated on at the Mayo Clinic by Doctor Judd, to whom I am indebted for the privilege of making this report.

Many cases of acute primary intussusception in young children, and chronic primary intussusception in adults have been reported in the literature, but of the chronic primary form in young children very little has been written. This is due not only to the rarity of the disease, but also to the fact that it is easily overlooked. Compared with acute invagination, the symptoms are much less striking, the child, who may simply appear to be unusually fretful, is not acutely ill, and so the condition is apt to be considered a slight intestinal disorder. While the symptoms, being obscure and indefinite, may suggest a wide field for diagnosis, there are certain features which are quite characteristic.

Wilms defines acute and chronic forms of intestinal intussusception as follows: 1. Very acute cases, death resulting in one or two days. (2) Acute cases, death resulting in from two to seven days. 3. Subacute cases, of one or two weeks' duration. 4. Chronic cases lasting two weeks or longer.

Other writers consider as subacute cases those in which the symptoms are of from one to four weeks in duration, and all cases in which the symptoms are of more than four weeks' duration as chronic. The division between the subacute and chronic cases is necessarily arbitrary.

There is a difference of opinion among writers with regard to the classification of the different types of intussusception. Probably the one most generally used is the following:

1. Ileo-iliac, or enteric type. One portion of small bowel becomes invaginated into another portion of small bowel.

2. Ileocaecal type. In the majority of cases, especially in children, the ileocaecal valve prolapses into the caecum. This becomes the apex of the intussusception, involving the ileum so that the caecum and colon form the outer and middle layers and the ileum forms the inner layer.

The ileocaecal type of intussusception is that which occasionally involves long tracts of the intestine. The ileocaecal valve may advance through the whole length of the large bowel and appear at the anus, or it may even

CHRONIC PRIMARY INTUSSUSCEPTION IN YOUNG CHILDREN

protrude through the sphincter ani. In all cases, however, the ileocæcal valve remains the apex of the invagination.

3 Ileocolic type. In this form the lowest portion of the ileum prolapses through the ileocæcal valve into the colon, so that the ileocæcal valve itself and the cæcum remain in their normal positions. The apex of the invagination is always formed by that portion of the ileum that first became prolapsed.

4 Colic type. One portion of large bowel becomes invaginated into another portion of large bowel.

Both of the cases reported here were of the ileocæcal variety. Weiss found that in 321 cases of intussusception, regardless of duration, invagination occurred as indicated in the Table.

TYPES OF INTUSSUSCEPTION

	Iliac Per cent	Ileocæcal Per cent	Ileocolic Per cent	Colic Per cent
Infants	24	42	10	24
Children	23	43	14	26
Adults	29.5	34.5	4.5	27

Lichtenstein, in 479 cases, irrespective of age or duration, found 52 per cent of the ileocæcal variety. Goodall in a series of cases of chronic primary intussusception in adults showed 70.3 per cent of the ileocæcal variety, 15.3 per cent enteric, and 13.5 per cent colic. However, he groups the ileocæcal and ileocolic cases under the same heading. Multiple invaginations, while very common in acute cases, are extremely rare in chronic cases, and are usually seen in the enteric variety.

The direction of the invagination is almost invariably descending, only a very few cases are to be found on record in which a retrograde invagination was present. Lichtenstein, who has compiled exhaustive statistics, found in a study of 500 cases of pathologic invagination of the bowel only eight of the ascending type.

Pathology. In chronic intussusception, œdema, necrosis, and gangrene, which are characteristic of acute cases, although not the rule, are not infrequently seen. The peritoneal attachments usually have time to stretch and as a result, the pull of the mesentery is less marked and the contractions of the bowel less violent, consequently, there may be little or no circulatory disturbance.

Adhesions may or may not be present. In the cases reported here they were of slight consequence, causing very little interference with reduction. However, in many cases dense fibrous adhesions are found and reduction is possible only after they have been cut. In Legueu's patient who lived one year, no adhesions were found at necropsy. Hypertrophy of the intestinal musculature is usually found proximal to the intussusception which may be followed by dilatation.

Etiology. The etiology in cases of chronic intussusception does not differ from the etiology in the acute primary cases.

Koch and Oerum, in a statistical survey of their work, including 107 cases previously published by Hirschsprung, remark that the geographical distribution of intussusception shows certain peculiarities. It would appear from formerly reported experiences that the English-speaking countries are especially subject to the affection, far more, for instance, than Germany or France. In Denmark and Great Britain, castor oil possibly plays a part in producing intussusception by the strong or irregular peristalsis which it induces. In Denmark mothers often use this drug indiscriminately of their own accord. It can scarcely be a mere chance that Denmark and Britain, the two countries where the greatest use and perhaps abuse of laxatives is made, should furnish the largest contributions to the statistics of intussusception.

Koch and Oerum distinguish two phases in the formation of an intussusception: 1. A primary circular contraction of the intestine. 2. The overlapping of the intestine.

The first phase is brought about by some abnormal irritation. The second phase was formerly explained as being the consequence of a contraction of the longitudinal muscles, but it was pointed out that the commencement of the overlapping was already affected by the circular contraction of the intestine which increases in length by depositing itself in the non-contracted part by means of a collar-like turning which smoothly increases by peristaltic action.

This explanation holds good not only for intussusception of the large bowel, but also for the ileocaecal forms when there is a circular contraction of the ileocaecal valve or of a part of the caecum. Experiments have shown that the caecal turning must be the primary event of the formation of the ileocaecal intussusception. Clinically, this mode of origin has also been substantiated at early operation.

Corbett has been able to produce artificial intussusception to a small extent by occluding the mesenteric circulation of the bowel both direct and collateral. Intussusception did not occur when large segments were tied off, but resulted from the complete occlusion of the blood supply to the small segments. These findings are corroborated clinically by the fact that thromboses are sometimes found in connection with intussusception.

The occurrence of an ileocaecal invagination is possible only when the caecum is "floating", hence, invagination is rare in the presence of cancer of the caecum which fixes the intestine to its surroundings. The floating caecum is found in 42 per cent of infants and only 17 per cent of older children, according to Leriche and Cavaillon.

REPORT OF CASES

CASE 192658—D. T., a boy, aged two and one-half years, was first examined April 20, 1917. The mother stated that ten weeks previously, after eating some cheese, the child began to have attacks of sharp, fleeting pains through his abdomen, lasting a few seconds. During the attacks he cried, held onto his abdomen, and refused to allow it to be touched. The attacks persisted from four to twelve times a day, and in the intervals he was apparently free from pain. The boy had three vomiting spells lasting two or three days, but it was definitely stated that the

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vomiting was not associated with the pain. The bowels had been constipated since the onset of the trouble, but previously they had been regular. There had been no diarrhoea, but considerable mucus was passed at times with occasional traces of blood. The mother had noticed a great deal of gurgling in the child's abdomen especially during attacks. There was marked loss in weight.

On physical examination the child was found to be fairly well nourished and weighed 22.5 pounds. There were a few palpable cervical glands, and the heart and lungs were normal. No mass could be felt in the abdomen as deep palpation was prevented by muscular rigidity due to crying. The abdomen apparently was not tender. Rectal examination was negative. The temperature was 98.8 and the erythrocytes numbered 12,800. Examination of the urine showed quantity 100 c.c., specific gravity 1.019, reaction acid, and the slightest possible trace of albumin. The microscopic examination was negative. The stool contained no ova or parasites. A Röntgen-ray examination of the colon was attempted, but the patient could not retain the bismuth enema. A diagnosis was made of intestinal obstruction.

At operation a primary ileocaecal intussusception was found. The ileum extended into the caecum for several inches, and both the caecum and appendix were markedly thickened. There was some obstruction in the ileum. A lateral anastomosis was made between the distended ileum and ascending colon. The appendix was removed. The patient recovered.

CASE 194833—L. B., a boy, aged three years, was first examined May 22, 1917. For ten weeks previous to examination he had had attacks of abdominal cramps lasting a few seconds and occurring about every five minutes, day and night. He cried out during the attacks which were aggravated by eating. There was no abdominal tenderness. The bowels had always been regular previous to the onset of the disease, but since then an evacuation had not occurred without the aid of cathartics. For five months previous to the appearance of these symptoms the child had been having vomiting spells, but there had been no vomiting during the illness itself. There had been a great deal of rumbling and gurgling in the bowels, usually after the attacks of pain. Neither mucus nor blood had been noticed in the stools.

Physical examination revealed a well-nourished child weighing 28.5 pounds. The cervical, axillary, and inguinal glands were palpable. No mass was palpable in the abdomen. Rectal examination was negative as was a roentgenogram of the colon. The temperature was 98.8 and pulse 108. The haemoglobin reading was 78 per cent and the erythrocytes numbered 15,400. Examination of the urine was negative. Diagnosis was made of chronic intussusception.

Operation revealed a primary ileocaecal intussusception. The caecum and the appendix were prolapsed into the transverse colon and both were greatly inflamed. The opening was dilated and the intussusception reduced. An appendectomy was performed with the excision of a piece of the mucous membrane of the caecum. The patient recovered.

Symptoms. Chronicity.—Chronic intussusception may develop after an acute attack has subsided or may occur as such from its incipency. Although the initial symptoms as a rule appear suddenly such an onset does not necessarily indicate an acute course. On the other hand the symptoms may develop gradually.

Both of the cases observed at the Mayo Clinic were of ten weeks duration. Cases in adults have been reported in which the attacks have occurred over a period of three or four years.

Pain Pain is the most prominent and distressing symptom. It occurs in paroxysms of abdominal cramps of varying severity and length. During the attack, which is of sudden onset, the child cries, doubles itself up, and often holds onto the abdomen. The pain ceases as suddenly as it begins, the child stops crying, and to all appearances is no worse for the attack.

In both of the cases reported the attacks lasted but a few seconds. In one it was definitely stated that the paroxysms occurred every five minutes and in the other from four to twelve times a day. In severe cases they may persist for several hours. The location of the pain is of little value and only serves to confuse the condition with appendicitis.

Vomiting is relatively less common in chronic than in acute cases. When it does occur as in one of these cases, it is usually at the onset and rarely during the course of the illness.

Stool The character of the bowel movements varies. The only thing that we can be certain about in regard to the evacuation of the bowels is its very uncertainty. The severity of the case has no relation to the condition of the stools.

In both cases the bowels had been normally regular, but had become constipated at the onset of the disease and remained so throughout its course. In adults, diarrhoea and constipation are of about equal frequency. Constipation is the usual condition found in enteric invaginations.

Blood and mucus, if present in the stools, are of material aid in the diagnosis. They occurred in only one of these cases. In chronic cases blood in the stools does not play the important part that it does in acute cases, in which it is of very frequent occurrence. Fraser states that a case which possesses the characteristic features of intussusception and yet shows no blood in the stools is almost entirely enteric in type. It might better be said that an enteric invagination rarely shows blood in the stools, because in many cases of ileocaecal intussusception blood is not seen. Occasionally intussusception occurring above the ileocaecal valve will produce blood in the stool.

Rumbling and gurgling are frequently present in all varieties of intestinal obstruction which occur usually either during or, as is more often the case, with the cessation of the colic.

Physical Signs In chronic intussusception in children tenderness is not marked and may be absent. Distention is another symptom which is quite variable but is rarely very pronounced.

Tumor In all forms of intussusception the presence of an abdominal tumor with its variations in size, position and consistency, either during or independent of an attack of colic, is very characteristic, but cannot always be palpated. Tumor is not always present, especially in the chronic type occurring in children. In both of the Clinic cases we were unable to detect a tumor. Still has shown that the muscular rigidity produced by crying when palpation is attempted can be obviated by examining the child during sleep. Chronic intussusception is frequently mistaken for tuberculous peritonitis. The transverse tumor associated with wasting simulates tuberculous peritonitis.

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with its mass of thickened, caseous omentum. The onset is more gradual. An unnatural emptiness in the right iliac fossa often helps to differentiate tuberculous peritonitis.

Gaping Anus. Broca, Moizard and Gandeau have called attention to the gaping of the anus in cases of chronic intussusception, and the symptoms led these authors to the proper recognition of two cases. They mention that this finding is never present in inflammation of the sigmoid flexure, in chronic intestinal catarrh, or in the course of a low grade of peritonitis. These symptoms have never been noted in our experience.

Röntgen-ray Examination. In one of our cases the patient was unable to retain the barium enema, in the other the X-ray of the colon was negative, and of no assistance. One should hesitate to place too great reliance on a roentgenogram of the colon in suspected cases.

SUMMARY

Chronic primary intussusception in young children is relatively uncommon.

The clinical and operative histories of two children operated on at the Mayo Clinic are recorded.

The symptoms may be vague and misleading, but careful investigation into the past history, and observation of the child during an attack, will often suggest the true condition.

Intermittent attacks of abdominal pain of sudden onset, occurring over a period of weeks or months, of short duration, and disappearing suddenly with complete relief, are characteristic.

REFERENCES

- Broca, Moizard, et Gandeau. Deux cas d'invagination intestinale chronique. *Bull. Soc. de pédiat. de Par.*, 1904, vol. vi, pp. 373-380.
- Corbett, J. F. Quoted by Foid, J. P. *Trans. West. Surg. Assn.*, 1914, p. 114.
- Fraser, J. Enteric Intussusception. *Edin. M. J.*, 1916, vol. xvi, pp. 275-279.
- Goodall, H. W. Chronic Primary Intussusception in the Adult. *Boston M. and S. J.*, 1910, vol. cxii, pp. 448, 491.
- Hirschsprung, G. La fréquence de l'invagination intestinale en Danemark. *Cong. period. internat. d. sc. med. Compt. rend.*, 1884. Copenh., 1886, vol. iii, sect. de pédiat., pp. 82-86.
- Koch, A., and Oerum, H. P. T. Intussusception in Children. 400 Danish cases. *Bibliot. f. Læger*, 1911, 8 R., vol. xii, pp. 333-484.
- Legueu, F. Invagination intestinale chez l'enfant. *Bull. Soc. anat. de Par.*, 1896, vol. lxxi, p. 161.
- Lichtenstem. Quoted by Nothnagel.
- Leriche R. et Cavaillon, P. Des conditions anatomiques nécessaires à la production des invaginations iléo-cæcales. *Semaine med.* 1907, vol. xxxii, p. 85.
- Rolleston, H. D. and Stengel, A. eds. Nothnagel's Encyclopedia of Practical Medicine. Diseases of the Intestines and Peritoneum. Philadelphia, Saunders, 1905.
- Still, G. F. Chronic Intussusception in Children. *Arch. Pediat.* 1921, vol. xxxviii, p. 174.
- Wilms. Quoted by Goodall.
- Weis, S. Intussusceptio intestini (Sammelreferat nach den Arbeiten von Lehre. 1894. In July, 1899). *Centralbl. f. d. Grangeb. d. Med. u. Chir.* 1899, vol. ii, pp. 702-72, 808, 839, 881, 913.

FASCIA TO FASCIA IN INGUINAL HERNIA OPERATIONS

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STUDIES of Major Seelig, St Louis, Mo (Transactions American Surgical Association, 1923) have recently drawn attention to the fact that muscle tissue does not unite to fascia when these two structures are coapted by suture in the sense that fascia unites to fascia. His experiments developed the observation that when muscle masses are united to white fascia, actual union occurs only between the white fascia and the connective-tissue elements forming the septa between bundles of the red muscle tissue.

Although instances in which at secondary operation an apparently firm union between red muscle and white fascia has been noted, these observations are hardly to be regarded as conflicting with the conclusions of Seelig, noted above, since, for example, the permanent attachment of Poupart's ligament to the red muscle of the internal oblique following suture may well occur through union of the connective-tissue elements of the muscle structures on the one hand and the white fascia of the ligament on the other.

These findings lend some encouragement to those who are accustomed to draw the conjoined tendon with the *falx inguinale* to Poupart's ligament over the cord with a view to strengthening the lower portion of the roof of the canal in operations for inguinal hernia, for here, connective-tissue elements are united to connective-tissue elements only. Fascia, it has been shown by Arthur Ayer Law and others, will unite to fascia under considerable tension. Thus, all surgeons have been able to prove clinically by noting success after operations in which it had been necessary to apply tension to bring the conjoined tendon to Poupart's ligament.

If it is true that tension does not interfere seriously with the union of these two connective-tissue structures, the fact can be utilized in those types of wide inguinal hernia in which owing to a relaxed condition of the conjoined tendon often associated with this pathology, the conjoined tendon can be drawn to Poupart's ligament at a level sufficiently low to reinforce the external ring. That is, this can be done if the fear of uniting these two structures under some tension be abandoned. Thus the transplantation of the rectus muscle as advocated by Bloodgood and the turning over of a flap of the anterior sheath of the rectus muscle as practised by Woelfler & Halstead, procedures requiring considerable time and art for their performance, may be less frequently resorted to if the firm edge of the conjoined tendon can be successfully drawn and held to the under surface of the even more firm fabric of Poupart's ligament.

The writer has in a few cases of wide hernia, utilized the plan of Bloodgood incising the sheath and suturing the belly of the rectus muscle to Poupart's ligament but has felt that this dislocation of an important anatomic structure does

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not often suffice to overcome the difficulty present. Merely incising the sheath of the rectus and the conjoined tendon to relax tension upon the sutures placed in the margin of the internal oblique and conjoined tendon is of course conservative and often helpful.

A difficulty encountered not infrequently in attempting to draw the conjoined tendon to a point low on Poupart's ligament, in order that the aperture of exit of the cord may be small enough, is due to the circumstance that the direction of fascia fibres in the conjoined tendon is such that ordinarily sutures passed successively through the edge of the conjoined

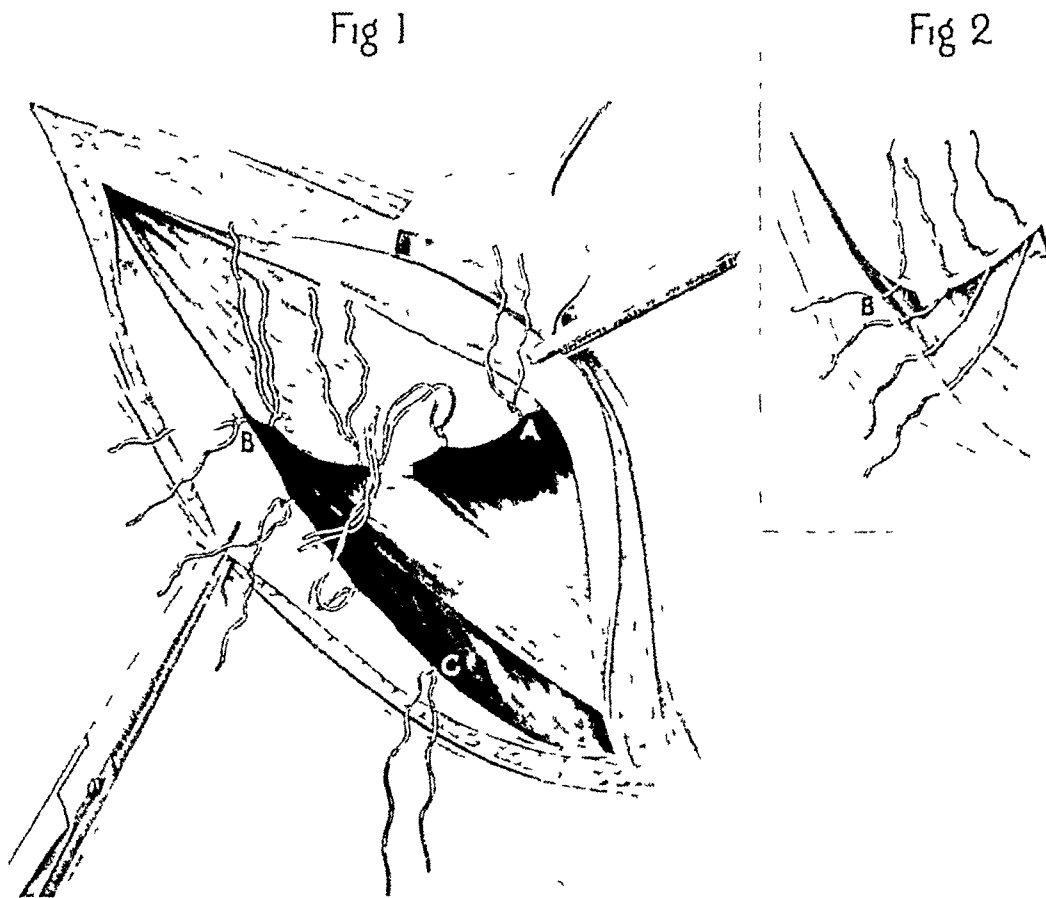


FIG 1 —Sutures fixed by hard knot do not split the conjoined tendon and make it possible to bring A to B by tying long double strands of knotted sutures

FIG 2 —Sutures passed thus through edge of conjoined tendon tend to split fibres when under tension bunching at B leaving defect wide open

tendon have a tendency to produce a splitting off of the edge of the structure and a sliding of the end of suture which traverses the tendon in a direction upward and outward so that when attempts are made to draw over that portion of the conjoined tendon which is near the attachment to the pubic bone the sutures split back, bunching so to speak, at point too high on the margin of the conjoined tendon to admit of a snug closure of the ring.

Binnie suggests that this trouble may be, to some extent obviated by taking care not to grasp with the needle the same longitudinal fibres each time.

A very simple expedient is of great help in overcoming this difficulty. It may be well known to many surgeons but because it has not been set forth in

the literature of the subject, in so far as it has been possible to discover, it is presented here for whatever it may be worth. It consists in passing a long, number one chromic catgut suture through the edge of the conjoined tendon and another such suture through the under surface of Poupart's ligament. These long sutures are tied in a hard knot at their middle so that they cannot split and slide. The long double strands are then tied together as shown in Fig 1. This plan of suturing makes it possible to unite a given point on the

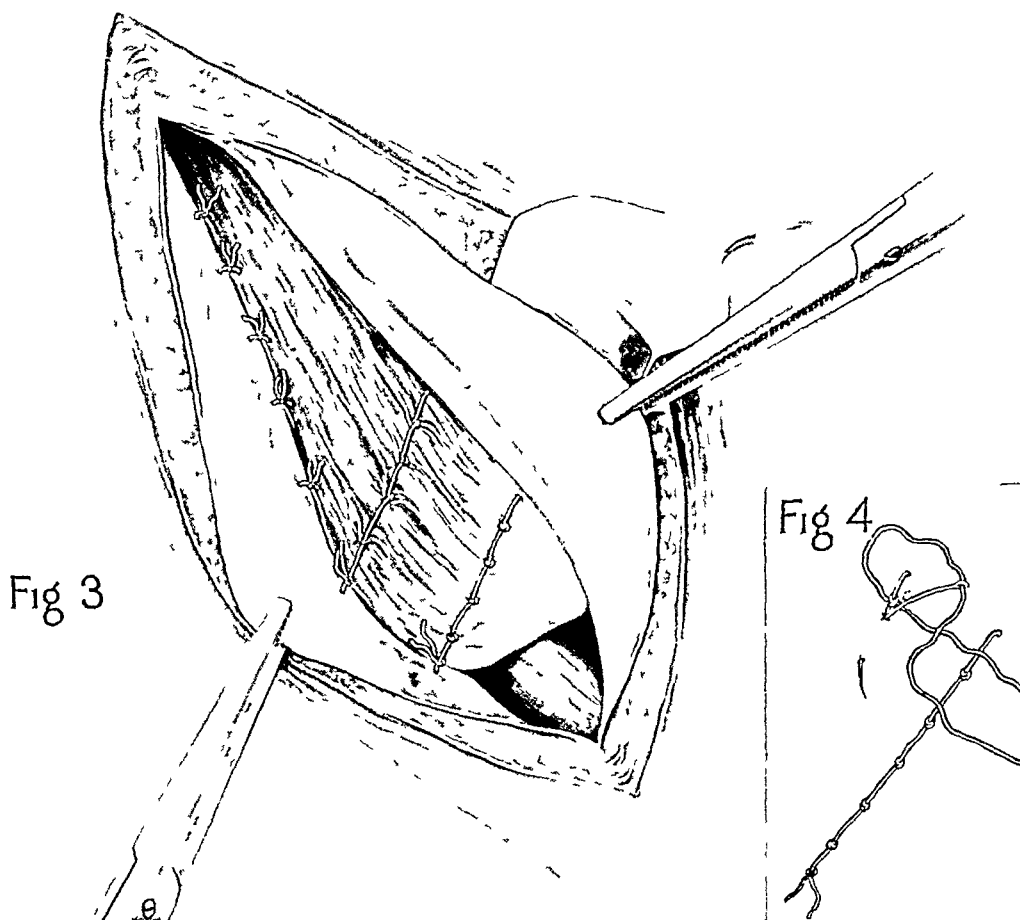


FIG 3 —Running knotted loop sutures woven into internal oblique and conjoined tendon holding them firmly to Poupart's ligament

FIG 4 —Diagram illustrating method of introducing knotted loop sutures

conjoined tendon to a given point on the under surface of Poupart's ligament which two points might be impossible of approximation with ordinary suturing, owing to the tendency to split back mentioned above. Mattress sutures and button sutures can hardly be made so effective as the knotted suture.

A running knotted loop suture, Fig 3, may be used to provide additional security in holding the conjoined tendon firmly in a desired relation to Poupart's ligament. This knotted loop suture quilts together the fibres of the conjoined tendon or the muscle bundles of the external oblique and transversalis, so

that the integrity of these structures is preserved when traction is applied to their arching border. Such a suture will not cut out unless the pull be very great indeed, for the tension is distributed between or divided among many points instead of one as in the case of the ordinary suture. In the case of wide herniæ, one or two such running knotted loop sutures may be used to reinforce the interrupted or continuous coaptation sutures such as are ordinarily employed.

The manner of introducing the running knotted loop suture shown in Fig. 4 is as follows. Beginning at the edge of the rectus sheath, the curved needle is passed into the conjoined tendon or the red muscle of the internal oblique and transversalis, as the case may be, and the point of the needle brought out about two-thirds of a centimetre nearer the arching border than it entered. The long suture is drawn through to a point near its middle and tied with a reef or hard knot as if one were tying off a blood-vessel, the knot falling over the aperture of exit or the opening nearer the arching border of the conjoined tendon. The needle is then passed back through the hole, under the knot for the second loop and the long ends are tied again over the opening at which the needle emerges. The last loop, of several thus introduced, embraces the edge of the conjoined tendon or the margin of the red muscle if applied higher up. Great traction may be applied to such a suture without tearing the tissues into which it has been woven. Simply passing one strand of the strong chromic catgut suture through the under surface of the notably firm Poupart's ligament completes a tension suture in which unusual confidence may be reposed. It is believed that employment of such a plan of suturing may make possible more extensive coaptation of fascia to fascia, which, in view of the recent studies mentioned above, is a matter of importance in establishing complete and firm closure.

HISTOLOGIC EVIDENCES OF INFLAMMATION IN THE SACS OF CERTAIN INGUINAL HERNIÆ*

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EARLY anatomists called attention to the various layers of fascia and muscle covering hernial protrusions, explaining thereby the origin and nature of these structures. This knowledge gave anatomical guidance in the dissec-

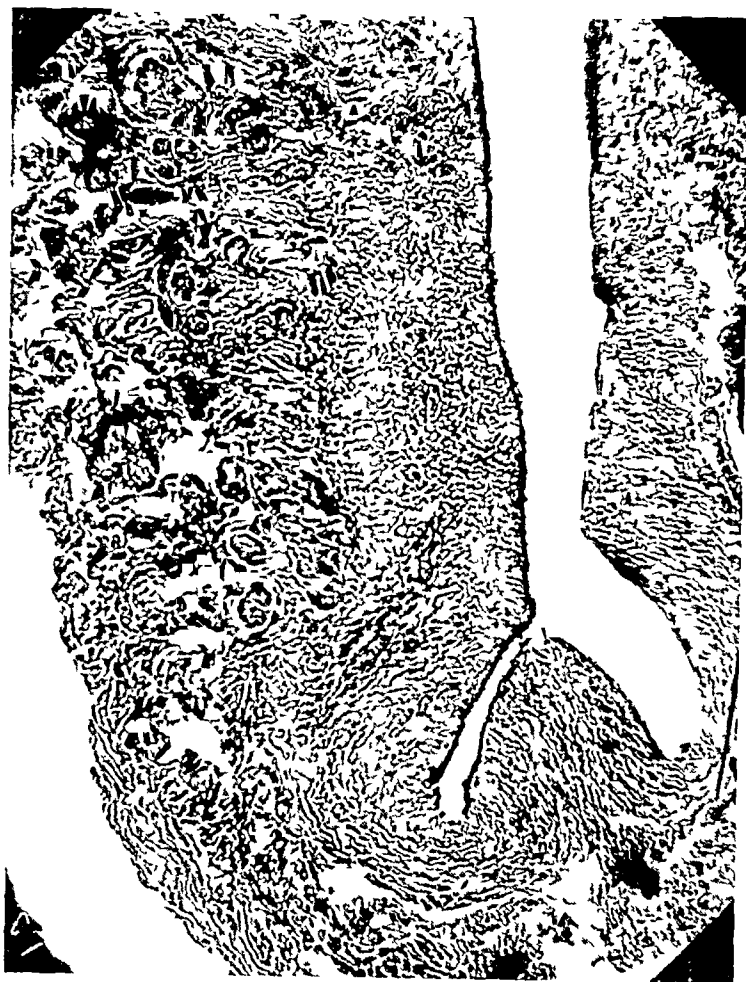


FIG. 1.—Fibrous hernial sac. Section of wall of sac showing usual structural arrangement in an adult with hernia of two months' duration (Low power.)

tion of inguinal region, in the freeing of the sac and dealing with its contents.

In more recent times based on autopsy and operative material, further knowledge has been added so that besides acute changes associated with incarceration and strangulation, a series of secondary pathologic changes which may occur in the chronic hernial sac are recognized. The hernial sac may become thickened with what is commonly regarded as a chronic inflammation, particularly when the intestine or omentum has been a part of its contents or when a truss has been worn. Under these circum-

stances adhesions between the sac and the contained intestine or omentum may be formed and irregular areas of obliteration of the sac have been described. The difficulty of freeing the sac from adjacent structures has given rise to the impression that a fusion of greater or less extent takes place between the outer structures of the sac and neighboring fascia and muscle. These

* Read before the New England Surgical Society, October 18, 1923.

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various fibrous changes are described by Kaufmann¹ and Choyce² and descriptive names have been applied to the special conditions encountered

Very little attention has been paid to the histopathology of the hernial sac and only an occasional reference is found, such as by Murray^{3,4} The extirpated sac has not been subjected to a routine histological examination as is the case with other tissues removed at operation The present paper deals with observations made on the histopathology of hernial sacs removed at operation and discusses various inflammatory reactions found It is based on 250 cases of inguinal hernia, the material being drawn from various

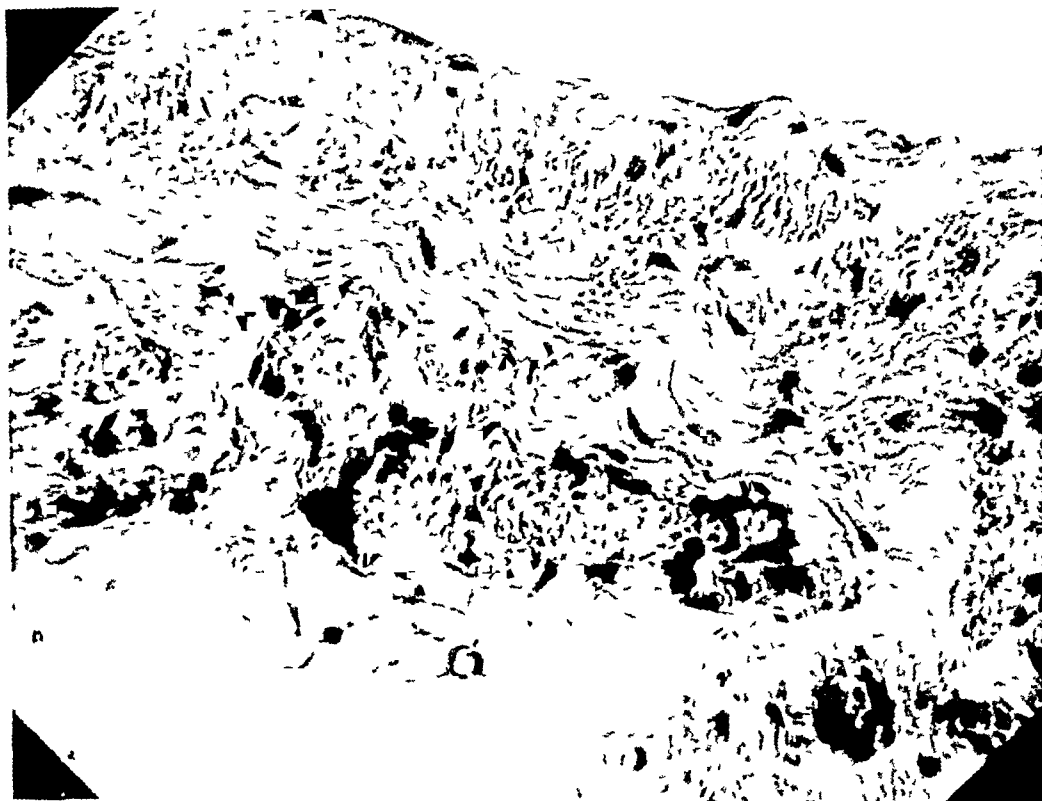


FIG. 2—Fibrous hernial sac showing arrangement of subendothelial connective-tissue in three layers, a superficial and a deep layer lying parallel, and a middle layer at right angles to the other two (High power)

sources, but in large part from herniæ occurring in individuals employed in brass mills who work under conditions of severe manual labor

The peritoneum of the internal ring of the infant at birth and also that of adults consists of a single layer of endothelium, resting on delicate connective-tissue with an intermingling of elastic fibres There is often a thickening of mild degree of the supporting connective-tissue, at the point of the internal ring where it admits the cord, with a well-defined pad of fatty tissue lying below the fibrous tissue elements

A microscopic study of both the indirect and direct forms of inguinal hernial sac shows that these fall morphologically in either case into two groups The first group may be called the fibrous hernial sac (Fig. 1) and is characterized by a dense fibrous sub-endothelial layer The fibrous tissue lies directly beneath the endothelium and supports the fine capillaries of

arteries, veins and lymphatics which course upward toward the endothelium from a vascular and lymphatic plexus lying in contact with the deeper parts of this connective-tissue zone. The subendothelial connective-tissue in some sections appears to be arranged in three distinct layers, a superficial and a deep layer lying parallel and a middle layer at right angles to the other



FIG 3 —A fibrous hernial sac, showing typical inflammation of the subendothelial connective-tissue associated with onset of hernia after muscular effort (Low power)

two (Fig 2). Externally the fibrous tissue layer lies in contact with structures such as muscle, fascia or the tissues forming the cord. Elastic tissue fibres are arranged in strong bands deep in the connective-tissue zone. They are conspicuous, as well, directly below the endothelium.

Fibrous hernial sacs have a tendency to become thickened in the progress of their development. They represent the more common form of hernial sac of adult life as well as that of infancy and childhood.

The second group may be designated as a fibrous-fatty hernial sac and is encountered particularly in direct

hernias (Fig 4). The subendothelial connective-tissue layer is delicate and relatively thin and rests upon fatty tissue. The fat in its turn externally lies in contact with neighboring muscle, fascia and structures of the cord. There may be an extensive invasion and replacement of subendothelial fibrous and elastic tissue by fat, so that nothing remains of the subendothelial connective-tissue zone but a fine line composed of fragmented hyaline strands supporting elongated and thinned endothelium (Fig 5). Such advanced fat invasion associated with fibrous and elastic tissue atrophy, doubtless represents a regressive change in the peritoneum of the sac. It is seen in both direct and indirect forms of hernia. The process was found far advanced in the case of man twenty-four years old as early as three weeks after the onset of

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his hernia. This fact suggested that certain atrophic changes in the peritoneum of the inguinal region acted as a contributing factor in the production of this hernia.

Evidences of inflammation may occur in both types of hernial sac (Figs 3 and 4) and the inflammatory reactions are noted chiefly in the subendothelial layer of the connective-tissue. This becomes swollen, broadened through an increase in connective-tissue cells and infiltrated with inflammatory cells. Except in very acute cases of incarceration or strangulation where polymorphonuclear leucocytes in large numbers invade the wall of the sac, the usual cells of inflammation are lymphocytes, mononuclear cells with a few polymorphonuclear leucocytes and eosinophil cells. Frequently these cells of inflammation are grouped about the smaller capillaries. At times the inflammation is seen only here and there in the sac, especially in small recesses formed by folds.

Small fresh hemorrhages are often found in inflammatory areas of the sac, attributable to trauma in handling of the sac at the time of its removal at operation. Of interest are the

occasional evidences of old brownish-colored pigment seen occupying the cell bodies of mononuclear leucocytes. This probably means that at some time previous to operation, minute hemorrhages occurred in the region of the inflammatory area of the sac, possibly associated with some form of trauma, and that blood pigments such as hemosiderin has been taken up by these phagocytic cells.

Hyaline changes in the connective-tissue are relatively frequent, and delicate connective-tissue fibres are transformed into bands of hyaline with

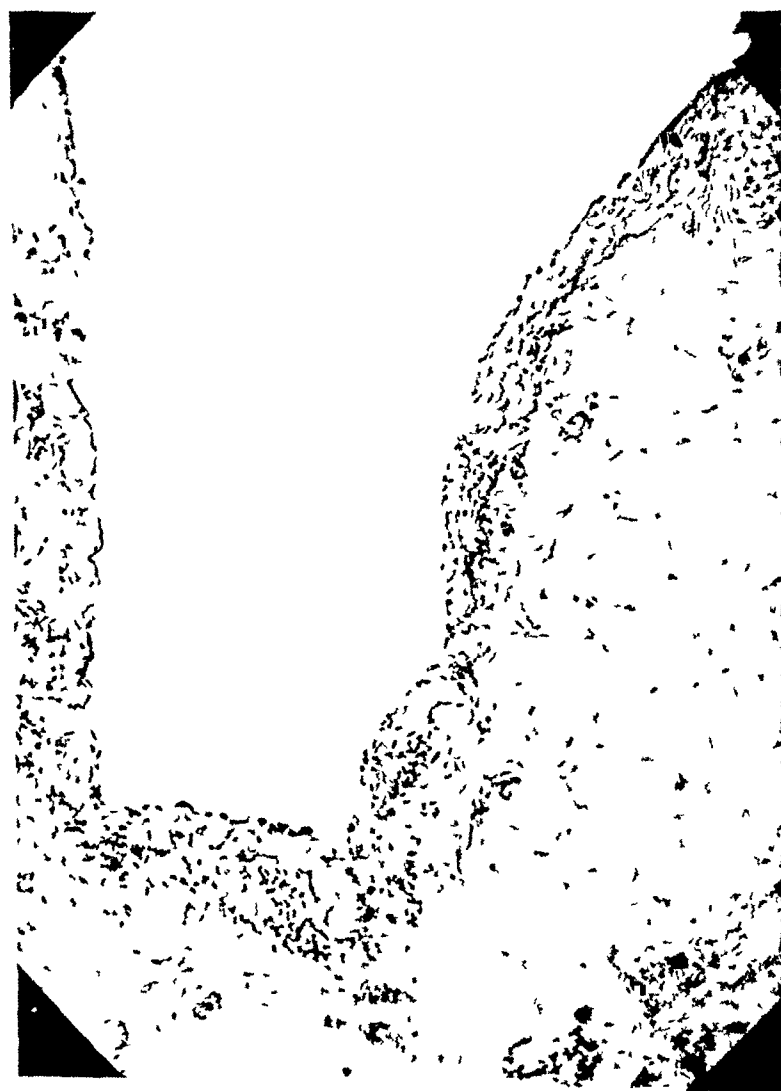


FIG. 4.—A fibrous-fatty hernial sac, showing mild inflammation of the connective tissue below the endothelium. This type of hernial sac is characterized by a relatively small amount of subendothelial fibrous and elastic tissue which rests upon fat. (Low power.)

only occasional and scattered nuclei. Calcification, bone and cartilage formation described by Choyce as occurring in sacs of hernias were not observed in this series.

In the older fibrous hernias there was noted an invasion of adjacent muscular structures with fibrous tissue, so that muscle bundles are split up and often atrophied in appearance. It is this fibrous fusion of the connective-tissue of the peritoneal parts of the sac with adjacent structures which is commonly encountered at operation when the sac is freed with difficulty.

Of importance from the standpoint of inflammation are certain areas of fibrous thickening lying directly beneath the endothelium. These can be seen on gross inspection of the inner surface of the sac and appear as grayish elevations, patches, plaques, ridges or bands found either in the fundus of the

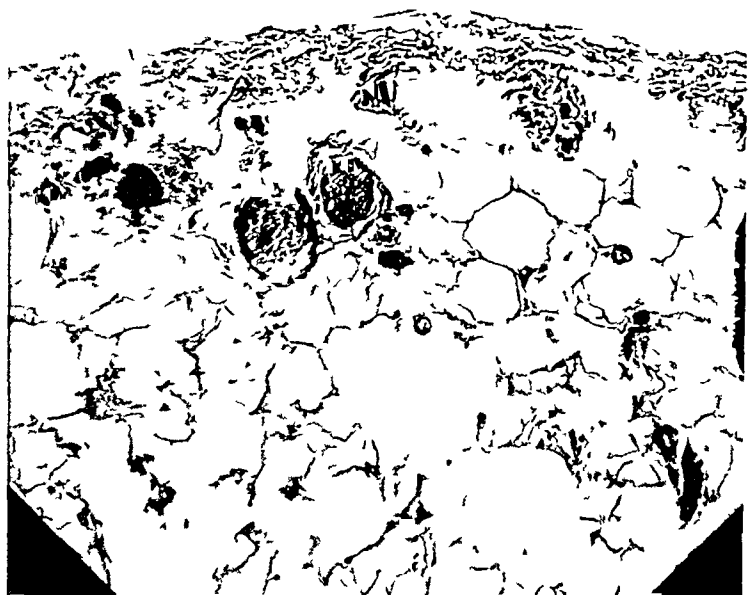


FIG. 5.—Fibrous-fatty hernial sac with extensive invasion of fibrous subendothelial tissue by fat so that only a few hyaline strands of former fibrous and elastic tissue remain. (Low power.)

sac or near the neck in the region of the internal ring. Patches of this kind are composed of dense connective-tissue and are well supplied with blood-vessels penetrating from the deeper lying vessels in the direction of the endothelial surface. At times such plaques show evidence of active inflammation (Fig. 6), but often this is not present. The simultaneous occurrence of

inflamed plaques with others which do not exhibit inflammation, can occasionally be distinguished in the same specimen. It is not unlikely that the plaques without signs of active inflammation represent a quiescent state following an earlier period of inflammation.

In the 250 specimens of hernial sac examined, thirty-seven showed evidences of active inflammation. It occurred under a variety of circumstances, in those who had not worn trusses and in those who had. The youngest patient was two years of age, while the oldest was seventy-two. At times there was an associated history of discomfort or pain, again, there were cases where the condition of inflammation was without clinical symptoms. In two cases, a very definite subacute inflammation preceded actual incarceration.

In one of the cases the inflammation of the sac was of tuberculous character (Fig. 7). This occurred in a man of thirty-five years who previously suffered from an active tuberculosis of the lung, but at the time of

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operation the pulmonary condition was in a quiescent state. Two months previously, following an unusual muscular effort while at work, he developed pain in the right groin and a small hernia. The tuberculous character of the sac was not recognized until a microscopic examination of the extirpated sac showed in areas of active inflammation a few minute tubercles containing giant cells lying directly below the endothelium.

In a second individual, a girl of twelve years, who twelve days before operation developed an inguinal hernia, an active inflammation of the sac was found with numerous giant cells of the foreign body type (Fig. 8).

In a third case, that of a woman thirty-two years old, who developed an incarceration in an inguinal hernia, several parasites resembling trichinæ

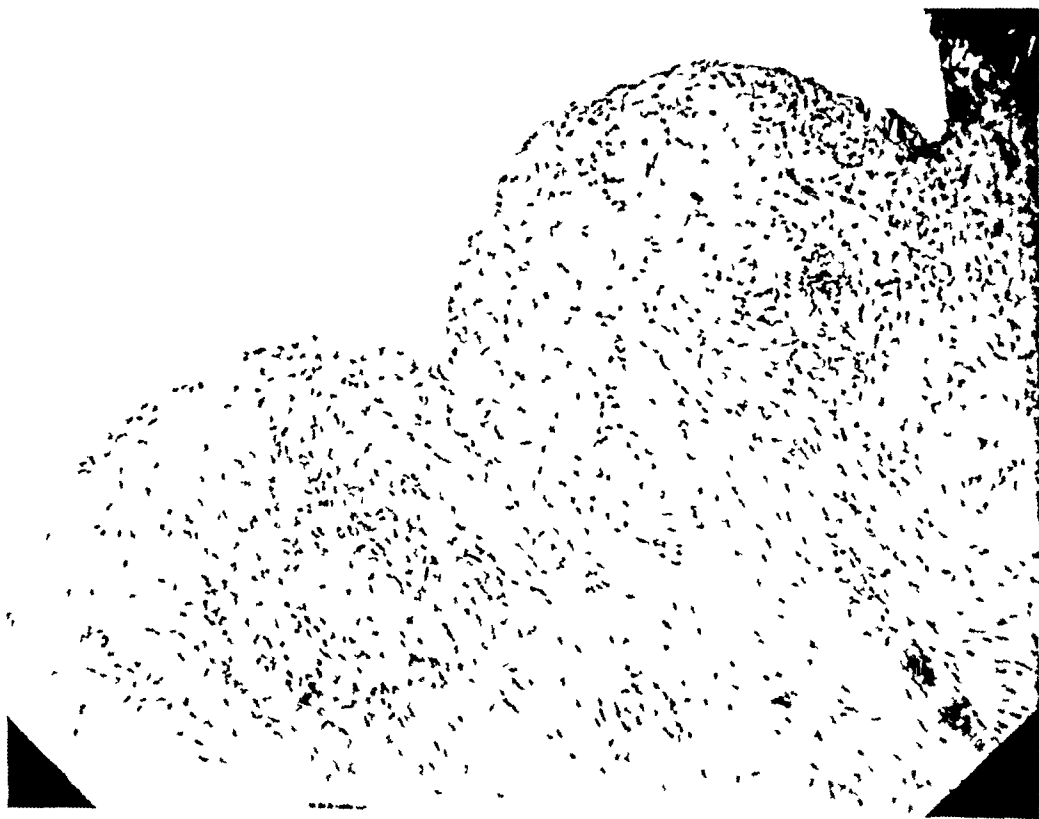


FIG. 6.—Fibrous hernial sac. A small fibrous plaque showing inflammation. (Low power.)

were found embedded in an actively inflamed subendothelial connective-tissue zone (Fig. 9).

It is the purpose, however, of the present paper to call attention particularly to the microscopic inflammation which occurs in a hernial sac soon after the development of hernia following muscular effort.

To illustrate this, brief extracts from histories of six cases are cited. The character of the inflammatory lesions are like those seen in Fig. 3.

CASE I.—A male, age forty-two, factory worker. Two weeks ago while lifting a heavy load developed severe pain in the right groin. This was not severe enough to keep him from working. Four days before admission noticed for the first time a small swelling in the right groin. At operation there were mild adhesions of the sac to adjacent tissue and a considerable amount of fat in the region of the cord. The sac was small, measuring about 3 cm., walls a little

thickened with some fat adherent to its outer surface. Microscopic examination shows a fibrous hernia with a marked inflammation consisting of lymphocytes, mononuclear cells, plasma cells and a few polymorphonuclears infiltrating the sub-endothelial connective-tissue which is thickened and rich in connective-tissue cells. The masses of inflammatory cells are grouped about the smaller capillaries, particularly in the deeper portions of the section.

CASE II—F B, male, thirty-three, laborer. Six days ago while at work he lifted some heavy weights and felt severe pain, developing a small swelling in the left groin. This swelling was not particularly tender. During the past few days it has become less marked. Examination showed no definite hernia but a ring admitting the tips of two fingers with a distinct impulse on coughing. On operation a small sac was found which showed no gross changes, but microscopically the following condition. Sections show a fibrous hernia with a very



FIG 7—Tuberculous inflammation of a hernial sac in a patient with chronic pulmonary tuberculosis who developed a painful hernia two months previous to operation. (Low power)

noticeable infiltration of the subendothelial connective-tissue with lymphocytes, mononuclears and plasma cells (Fig 3). The subendothelial connective-tissue is increased in amount and rich in nuclei. Some of the mononuclear cells contain old blood pigment.

CASE III—M M, female, age twenty-three, housework. One week ago following effort at lifting, felt marked pain in the right inguinal region without nausea or vomiting. This pain has been of varying intensity ever since then. She noticed at the time of the onset of pain a small almond-shaped mass in the groin. Operation disclosed an indirect hernia with a small sac without any gross changes. Microscopic examination shows a fatty hernia with the delicate fibrous tissue lying directly beneath the endothelium, infiltrated with a large number of lymphocytes, mononuclear cells and a few polymorphonuclears. Directly below the connective-tissue zone the sac is composed of fat which shows no inflammation.

INFLAMMATION IN THE SACS OF CERTAIN INGUINAL HERNIAE

CASE IV—L S age forty-eight male laborer Seven days ago thought he had a slight cold or grippe This apparently did not confine him to bed and about this time he developed a pain in the right groin and over the region of McBurney's point At the same time he noticed a small swelling in the right inguinal region, the size of a walnut At operation there was found a small indirect hernia and an atrophied appendix, which was removed Microscopic examination of the appendix showed chronic atrophic changes without inflammatory cells Examination of the hernial sac showed the following condition There is a thick fibrous hernial sac with a well-defined inflammation below the endothelial lining Inflammatory cells consist chiefly of lymphocytes, a few mononuclear cells and plasma cells The tissues external to the peritoneal lining of the sac are considerably thickened, but no inflammatory cells are found in this region

CASE V—Age forty-nine, male, brass worker For the past week following heavy lifting patient has noticed a small, slightly painful mass in the left inguinal region Operative findings showed an indirect hernia and microscopic examination disclosed a fibrous type of hernial sac with here and there small thickened plaques A section

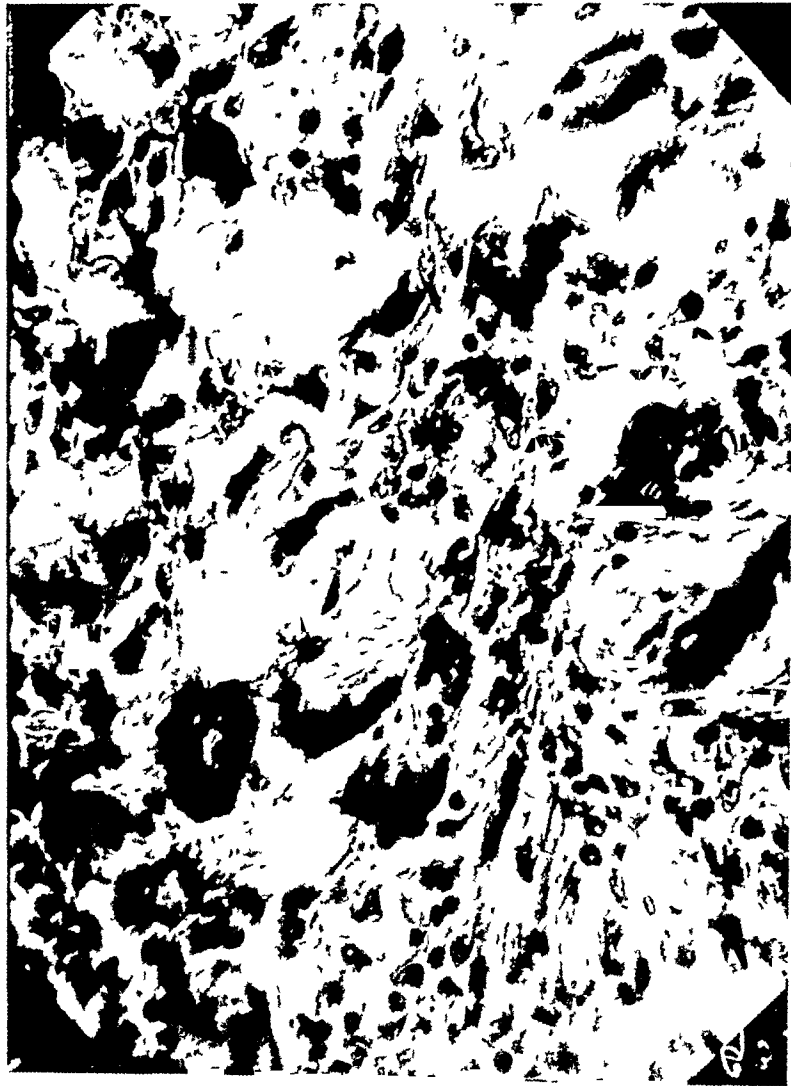


FIG. 8.—Inflammation of hernial sac showing foreign-body giant cells in the case of a girl of twelve who developed a hernia twelve days before operation. (High power)

of one of these patches shows a very striking round-cell inflammation Polymorphonuclear leucocytes are not present There are considerable mononuclear cells some containing brownish pigment

CASE VI—D C age thirty-two male, brass worker Four days ago while at work in the casting shop noticed for the first time a painful swelling in the right groin and came immediately to the hospital for examination There is a small hernia about the size of a walnut in the right groin somewhat tender on examination but not giving him enough pain to make him stop working On close questioning the man says that three weeks before he made an unusual

muscular effort in lifting while at work and states that ever since that time he has felt discomfort and slight pain in the groin, but he paid little attention to it. Operation showed a small indirect hernia about the size of a walnut without any gross indication of inflammatory changes. Microscopically there is a delicate fibrous hernia with a very well marked inflammation of the subendothelial connective-tissue cells with lymphocytes and mononuclears.

From the foregoing histories it is noted that the onset of some forms of inguinal hernia, particularly those brought on by muscular effort or strain, may be associated with a very characteristic inflammation of the subendothelial connective-tissue of the hernial sac (Fig 3). This inflammation is noticed



FIG 9 —Inflammation of a hernial sac due to parasite *Trichina Spiralis*. This parasite is embedded in the subendothelial connective-tissue of the sac. (High power)

only in microscopic study of the sac, the gross appearance in no way suggesting an inflammatory condition.

The cases cited were histories of hernia which came to operation soon after the development of their condition, without any indications of imminent incarceration or strangulation. They represent, therefore, ordinary hernias operated on at an early stage and the associated inflammation of the sac may therefore be linked with the early development of the process of hernia formation. All were reducible and without evidences of adhesions in the sac.

From the study of a series of 250 cases it was quite obvious that all hernias do not show such an early inflammation associated with onset, for numerous instances were noted where the sac showed no inflammation at all. This curious inflammatory reaction associated with onset of hernia is a low-grade, subacute process, and seems to be quite different from the usual acute

INFLAMMATION IN THE SACS OF CERTAIN INGUINAL HERNIAE

manifestations of inflammation in hernial sacs where an incarceration or strangulation of the hernial contents has occurred and rapid polymorphonuclear invasion of the wall of the sac develops

The progress of inflammation of hernia sacs associated with the onset of hernia is a matter of speculation. It is not unlikely that with the adjustment of mechanical conditions at the site of hernia the inflammation subsides, leaving possibly thickened patches in the wall of the sac, or encouraging the formation of adhesion between intestine or omentum and the peritoneal lining of the sac

SUMMARY

1 Microscopically, inguinal hernial sacs may be divided into two groups. Group 1, the fibrous hernial sac, representing the usual hernial sac of infancy and childhood and the more common form seen in the adult. It has a tendency to become thickened in the progress of its development.

2 Group 2, the fibrous fatty hernial sac. There is a tendency of fatty tissue to replace the fibrous and elastic tissue situated below the lining endothelium.

3 Inflammatory changes were found in thirty-seven out of two hundred and fifty inguinal hernial sacs removed at operation.

4 Inflammation occurred under a variety of conditions in the form of aseptic inflammation, infectious (tuberculous), or by parasites (*trichina spiralis*).

5 A subacute inflammation of the subendothelial connective-tissue of an inguinal hernial sac may be associated with the onset of hernia following muscular effort.

REFERENCES

¹ Kaufman, E. *Lehrbuch der Speziellen Pathologischen Anatomie*, 1911, vol. 1, p. 473.

² Choyce, C. C. *A System of Surgery*, 1915, vol. II, p. 587.

³ Murray, R. W. *Is the Sac of Femoral Hernia of Congenital Origin or Acquired?* *ANNALS OF SURGERY*, 1910, vol. II, p. 668.

⁴ Murray, R. W. *Hernia Its Cause and Treatment* 1910 London.

CHRONIC RETENTION OF URINE IN YOUNG BOYS DUE TO OBSTRUCTION AT THE NECK OF THE BLADDER*

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OF NEW YORK, N Y

ABOUT eight years ago under the title "Chronic Retention of Urine in Children," I brought together a study of this condition as illustrated by a series of nine personal observations and published same in the *Journal of the American Medical Association*. Since this publication it has been my good fortune to be able to study more than twenty cases of the same condition. I propose in this paper to describe three of these cases, treated by me with considerable success and again call attention to this unusual clinical entity.

Judging from literature, this clinical picture has very rarely been observed either by pediatricists or by surgeons. In view of the above, it has been necessary for me in working out the clinical entity and its treatment, to interpret the clinical picture and its causation without the usual cooperation that one obtains from other clinicians who have observed the same condition. During recent years, medical men hereabouts seem to be recognizing this condition more and more frequently and a number of them, appreciating the importance of the pathological changes, have referred such cases to me. On one day, about two years ago, two cases of this type were brought to my office for diagnosis and treatment. In my original paper in the *Journal of the American Medical Association*, various etiological factors underlying this condition were mentioned, against others, congenital obstructions in the male urethra, deformities of the bladder, such as diverticula, stones in the bladder and last but not least, neurological disturbances which cause a disharmony between the sphincter at the neck of the bladder and the detrusor muscles. The major number of the cases reported in that paper fitted into the latter group as no obstruction in the urethra, no stone in the bladder, no diverticula was demonstrable. As the condition occurs only in male children, the problem of causation has been particularly difficult prior to the introduction of the cystoscope and urethroscope suitable for exploration of the urinary organs in children.

The clinical picture briefly is the following. The parents report enuresis day and night with perhaps straining at urination, dribbling is a frequent symptom. When the urinary organs become infected, pyuria, perhaps accompanied by pain over the bladder as well as in one or both kidneys, may be a permanent symptom. The patients, suffering as they are from chronic sepsis gradually lose ground, become pale and pasty, and look like chronic nephritics. Such patients, if sufficient kidney parenchyma is destroyed, actually are suffering from renal insufficiency. On physical examination after voiding urine, which may or may not be turbid, which may or may not be

* Read before the New York Academy of Medicine, October 18, 1923

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passed in fair stream, there is regularly to be felt in the hypogastrium a symmetrical, often centrally placed, tumor which is an enlarged distended bladder containing residual urine. This mass can be regularly emptied with a catheter which proves the diagnosis. At times the mass is asymmetrical and to one side, and then from palpation alone there may be some doubt as to the nature of the tumor until the catheter is passed. If infection has set in, the mass may be very tender, and if it is deflected to the right side, it has been mistaken for an appendicular abscess. The pathological findings in some

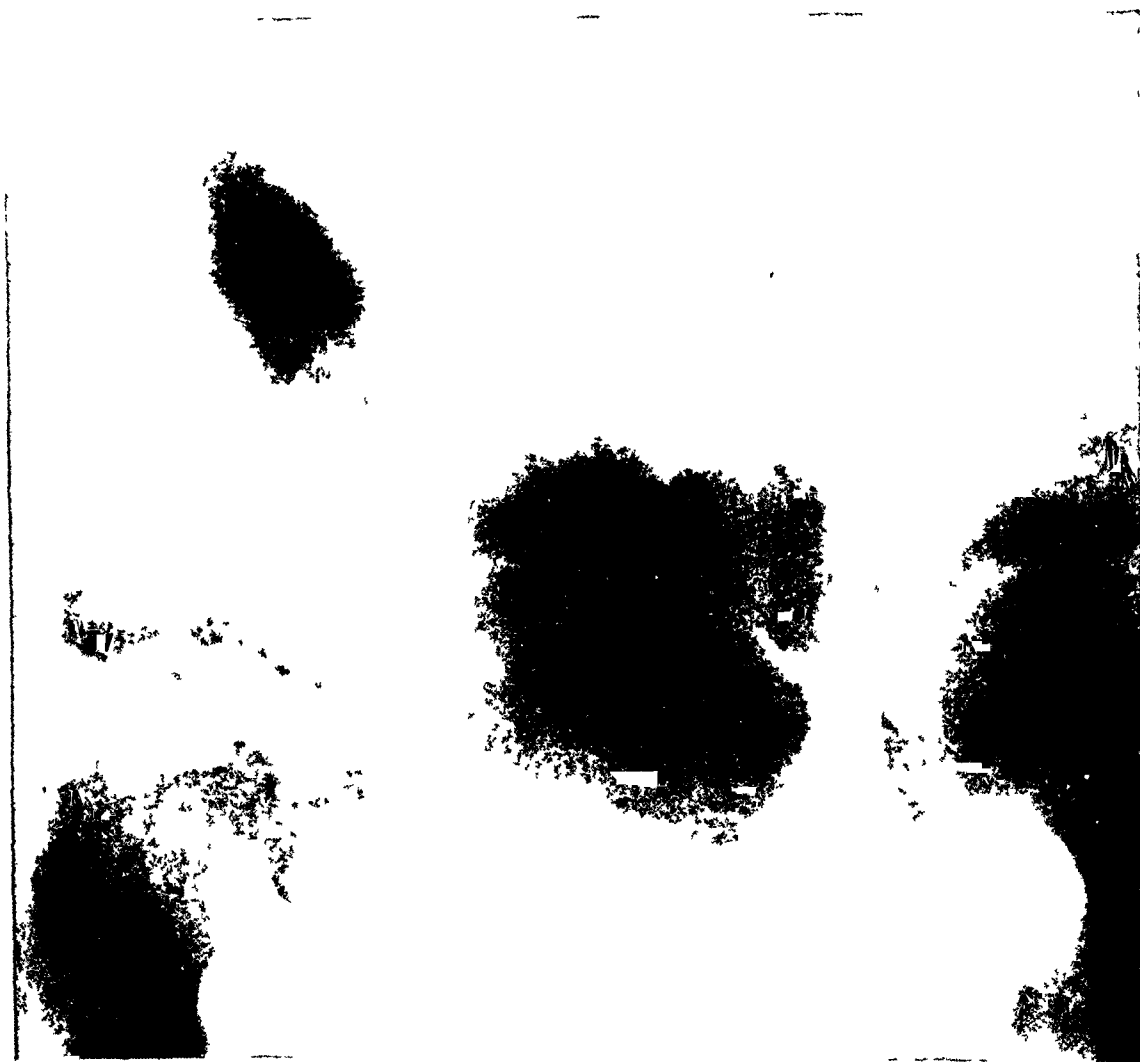


FIG. 1.—Case I W. M. Chronic retention of urine in a child. Cerebral birth palsy. Residual urine 6 to 12 ounces. Extensive diverticulation of the bladder. Dilatation and infection of left ureter and left kidney. Operative findings: contracture of the neck of the bladder.

half-dozen cases that have come to autopsy—which is the end result of untreated cases—show no obstruction in the posterior urethra or in the anterior urethra, in that larger group of cases which originally I thought might be explained on a peripheral or central neurological basis. The bladder in these cases is much hypertrophied and pouched; one or both ureters are distended, dilated, one or both kidneys are hydronephrotic or pyonephrotic depending upon the presence of infection or not. Examination of the spinal cord in the few cases examined has shown in the sacral region what has been interpreted as an infiltration of inflammatory character near the anterior horn

cells In other cases there has been a delayed myelinization The neurological findings have not been very conclusive With these preliminary remarks, I place on record three cases, all of which have been treated operatively

CASE I—W M The first case has been under observation for almost twelve years and it was the study of this case that allowed me to come to a correct interpretation of the condition and its proper treatment When first seen, the boy was six years of age and the complaint was difficulty in urination He was a face presentation and remained asphyxiated for one hour and a half after birth Anuria was present for a week after birth but this is not certain, thereafter,

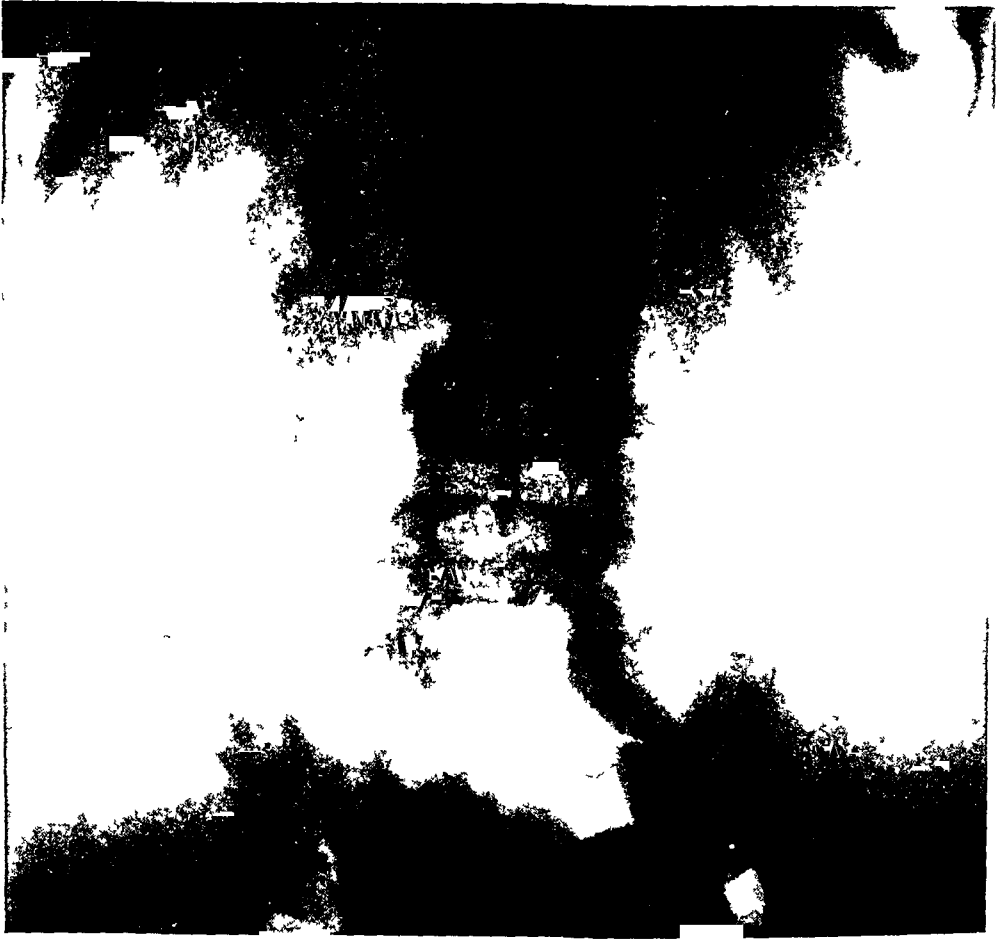


FIG 2—Case I W M Chronic retention of urine in a child Cerebral birth palsy Residual urine 6 to 12 ounces Extensive diverticulation of the bladder Dilatation and infection of left ureter and left kidney Operative findings contracture of the neck of the bladder

the patient dribbled At the age of two there was pain on urination At three he began to walk and the left side of his body was noted as weak There was frequency of urination and straining, the straining was so severe as to cause pallor, weakness and general distress When first seen, he looked pasty, underdeveloped and pale suggesting chronic nephritis On physical examination, in the hypogastrium there was a hard tumor which disappeared on catheterization His neurological examination showed a left-sided weakness, bilateral Babinski, with atrophy of the intrinsic muscles of the hand suggesting an old cerebral hemorrhage or Little's disease, plus a cervical cord poliomyelitis Cystoscopy made in 1912, showed a trabeculated bladder with delayed secretion from both kidneys as tested with indigocarmin, a diagnosis of retention of urine, some twelve ounces of residual urine being obtained, due to neuro-muscular disturb-

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ances caused by injury at birth. It was thought that there was a sphincter spasm or contracture, and progressive dilatations with bougies were instituted. After the passage of such bougies, the patient was able to empty his bladder. The patient was again seen in March, 1915, still pale and general appearance of nephritic. The bladder was two-thirds up to the umbilicus. On straining, the patient could void only one-half ounce of urine which was clear. At irregular periods, the neck of the bladder was dilated until March, 1921 when the boy had grown sufficiently to permit of a urethroscopic examination. This time he had ten to sixteen and a half ounces of residual urine. His bladder was trabeculated and full of pouches. His posterior urethra at the neck of the bladder showed a thick bar formation such as one sees in adult contractures of the neck. His right kidney secreted indigocarmine in faint concentration in fifty-five minutes. The left kidney was practically negative. The urea on the right side was 13 per cent, on the left 6 per cent. There was no pus present in either kidney specimens. His Wassermann was negative. His neurological status was unchanged and his blood chemistry was Urea N 21 mgm, Incog N 52.5. In view of the urethroscopic findings, it looked as if we had an explanation for the disturbance in this particular case. X-rays showed a diverticulated, large bladder and bromide ascended the left dilated ureter. On April 30, 1921 a suprapubic cystotomy was done and a large wedge was excised from the neck of the bladder. This wedge showed muscle tissue with fibrosis. No other obstruction was felt in the posterior urethra, either with an instrument or after dilatation with the examining finger. The patient was discharged in June, 1921, with a residual of one and a quarter ounces of urine. In February, 1922, the patient's symptoms recurred and stones were found (in another hospital) in the patient's bladder. These were removed and suprapubic drainage again instituted. The patient came under my observation again on February 17, 1922 when we found that the left ureter and kidney, which had become infected contained numerous calculi which were being fed into his bladder and obstructing his neck. On February 19, 1922, before one of the genito-urinary societies a complete nephro-ureterectomy for infected calculous hydro-uretero-nephrosis was performed. The patient made a good convalescence. When seen on January 11, 1923, his residual was four ounces and he had gained twenty pounds. His frequency of urination during the day was one and a half hours and once to twice at night. His urine on June 18, 1923 was clear, and his frequency was as above. Urgency at times was so marked that he had to use a bag after voiding. His residual was one and a half to two ounces. At night his bladder capacity was as much as twelve ounces which he voided in a good stream. This, then, is a patient under observation a long time for chronic retention of urine, associated with an extensive neurological disturbance, almost completely relieved of his residual urine or chronic retention by excision of the neck of bladder. (Vide Figs 1 and 2.)

CASE II—I S. First seen in December, 1921, at the age of six. Since baby-hood has been dribbling, has had headaches and nausea. He was delivered normally but was blue at birth. There were no convulsions, no paralyses. Neurological examination was negative, as was the spine. He passed water in good stream but after voiding, his bladder was almost up to the level of the navel. If the patient voided in steps, that is, at three to five minute intervals, he could reduce the size of the bladder mass by evacuating urine at each attempt. His residual urine was twelve ounces. Cystographic study showed a large columnar diverticulated bladder with a left hydro-uretero nephrosis. Cystoscopy showed poor indigocarmine output, right kidney was not delayed whereas left was. Bladder was full of purulent urine and in the posterior urethra with a urethroscope a bar formation was seen at the neck and no congenital folds were visible. The patient was prepared for operation by the use of a permanent catheter. He had a high temperature left kidney was tender and the urine continued purulent. His blood chemistry was normal whereas his phenolsulphonphthalein test in the first two hours was 5 per cent and in the next two hours 10 per cent. He weighed 33

pounds On January 16, 1922, a suprapubic cystotomy was performed and thick foul pus was seen coming from the left ureter orifice No folds were felt with a probe in the posterior urethra The neck of the bladder seemed minute and rigid as well as inelastic A wide "V" excision was made through the posterior lip of the sphincter after it had been stretched, and the mucous membrane of the bladder was attached to the mucous membrane of the posterior urethra, with a mattress stitch placed on each side to control bleeding The pathological report showed a section of the bladder wall with an area of chronic inflammation under the mucosa On February 11, 1922, the patient weighed 41½ pounds, his bladder wound was closed nicely and the patient was discharged on this date voiding urine



FIG 3—Case II I S Chronic retention of urine in a child Cystogram showing large bladder and dilated left ureter

in excellent powerful stream His suprapubic wound opened after his discharge from the hospital on several occasions but rapidly closed again When seen on December 30, 1922, the patient was in excellent condition There was no tenderness over either kidney and there was no dribbling of urine The patient voided in good stream and no mass could be felt after voiding in the hypogastrium This is another case, then, of chronic retention of urine in a child due to an obstruction at the neck of the bladder which had led to a marked left hydro-uretero nephrosis where, after excision, the bladder emptied itself satisfactorily, the dribbling ceased, nocturnal enuresis was done away with and the general health of the patient was marvelously improved (Vide Case II, Fig 3)

CASE III—A L When first seen on December 6, 1922, was 8½ years of age There was no difficulty at birth and no paralysis The patient's parents noticed one month before their visit to my office that the urine was purulent, that there was

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marked frequency and vomiting. The patient was well nourished, voided in good stream, and after voiding very turbid urine, his bladder continued full up to the navel. After voiding at the hospital some 500 cc of foul urine, a catheter was introduced which drained off within an hour over 1500 cc of purulent urine representing residual urine plus what there was in the ureter and pelvis on both sides, plus whatever had been secreted during the time that the catheter was in the bladder. His phenolsulphonephthalein test showed 5 per cent in six hours. His blood urea was 37.8 mgm. Neurological examination and X-ray of the spine were negative. The patient was evidently uremic, very drowsy and apathetic. Cystogram showed a large diverticulated bladder and bromide ascended both



FIG 4—Case III, A. L. Chronic retention of urine in a boy. Cystogram showing ascent in both ureters.

wide open ureters. The patient's bladder was emptied intermittently through an indwelling catheter, and when his condition, which was always desperate, seemed slightly improved, without any preliminary cystoscopy or urethroscopy, a cystotomy was done, on November 15, 1922, and within the bladder close to the sphincter a fold of mucous membrane was found which acted as a valvular obstruction to the outflow of urine. This was excised into the neck. Jets of pus were seen coming during the operation from both the dilated ureter openings. The patient made an excellent convalescence, the wound closed then re-opened on several occasions. Under bladder irrigations the condition of his urine improved somewhat and the patient rapidly grew taller and fatter, his residual urine dropped to less than one-half ounce, and when last seen on August 11, 1923, his weight was 69 pounds, he voided in good stream, the suprapubic wound had been closed for several months, his urine still contained pus, and his residual urine was one-half ounce. (Vide Case III, Fig 4.)

LOCOMOTION AFTER IMPACTED FRACTURE OF THE NECK OF THE FEMUR

By KELLOGG SPEED, M D

OF CHICAGO, ILL

THE two following instances of impacted fracture of the femoral neck where the patient was able to walk after the accident, have come to me within the last year

CASE I—Mrs R E W, widow, aged sixty-four years, was referred to me on August 30, 1922, with the history that seventeen days before she had fallen

on the floor and injured her left hip. She was helped up, but could walk alone, and had but little pain. She had broken this same leg in childhood just above the ankle, but had sustained no other injury since. After a few days ecchymoses appeared about the hip and because the pain did not completely disappear a physician was called. She was sent to the hospital and a skiagram of that hip was taken (See Fig 1). This clearly revealed an impacted fracture of the neck of the femur. The trochanteric fragment is apparently driven up into the head, which is rotated downward and inward, so that if there were no over-



FIG 1—The rotation of the head with an increase of the angle of the femoral neck and the deep impaction of the neck into the trochanteric fragment are clearly seen. The angular deformity with overriding is shown on the inner side of the neck.

riding a slight lengthening of the leg might have resulted. The neck axis instead of being reduced below 130 degrees as in the usual fracture of the neck of the femur, seems to be increased about 8 degrees. On examination, I found that the greater trochanter was situated about three-quarters of an inch above the Roser-Nelaton line, and measurements of the leg showed a shortening on this side of about one inch. These two findings fitted in with the overriding impaction shown in the skiagram. There were ecchymoses still present about the hip and some tenderness

IMPACTED FRACTURE OF THE NECK OF THE FEMUR

on deep pressure over the head of the femur, with scarcely any tenderness when the trochanter was struck light blows. Her leg was in normal axial position and the foot could be turned with some limitation of inward rotation. She could raise the leg and foot off the bed freely and had been walking about with no support since the accident.

Fearing that a disimpaction might result from use and slight twists, she was kept in bed about one week and then being fitted with a walking caliper, was allowed to get up and to walk. She wore the caliper about eight weeks, since when she has walked unaided, with no limitation of hip motion, but with a persisting leg shortening of one inch.

CASE II—Mrs H. P., a widow, sixty-five years of age, was sent to me May 22, 1923. She had fallen the day before from a step ladder. I found an impacted Colles' fracture of the left radius with fracture of the ulnar styloid. She also had injured her left hip, but had been able to walk after the accident, at first with some assistance. She had climbed the hospital stairs from her automobile when she was brought for attention. She could raise the left leg and foot from the bed readily.

The trochanter was found to be one inch above the Roser-Nelaton line. There was some tenderness in the hip region, but no crepitus nor pain when the trochanter was pounded. When her legs were measured, the left was one inch shorter than the right.

Skiagrams were taken proving the wrist fracture and showing also an impacted fracture of the neck of the left femur (See Fig. 2). The fracture plane lies higher up near the head in this patient. The trochanteric portion of the neck is driven into the head, which is rotated downward and inward. In this instance likewise the angle of the neck, instead of being reduced, is slightly exaggerated and the impaction does not seem quite so firm as in the first patient. Fearful of a bony separation, her leg was attached to an old-fashioned Liston splint for about ten days. Meanwhile a walking caliper was ordered and as she was rapidly gaining use of her left hand following reduction of the Colles'



FIG. 2.—This fracture is high up into the head of the bone. The head of the femur in this case is also rotated so that the neck angle is increased instead of diminished. The impaction is deep and on the outer aspect of the neck more than the inner on account of the head rotation. The overriding is plainly seen again on the inner aspect of the neck.

fracture, she was allowed to leave the hospital, using the caliper and a cane. A week later she was walking out of doors and within six weeks made a railroad journey to the Atlantic coast, travelling without the caliper or support of any kind. I have seen her within a week and she has no limp and gets about with spryness. The leg shortening still persists but has not increased.

To bring about this happy impaction I believe several factors are required. The break in the neck must come before or simultaneously with the impact of the hip on the ground or other object. To maintain or increase the neck angle as seen in these two patients, the leg must not be in adduction, but following the severance of the neck, when the leg was started into adduction, as is shown by the head rotation inward and downward, the powerful external rotators of the femur must act to pull the shaft and trochanteric portion out into abduction. At this instant the impact of the body weight striking the ground, transmitted through the hip, must firmly mesh the two fractured surfaces together so that they hold their position and will tolerate weight bearing and use. Should the impaction be of insufficient depth or at an angle less than the normal angle of the femoral neck, we may expect that the impaction will be broken up by attempted use or manipulations and the usual displacement of fragments will result. This mechanism is much like that which causes intertrochanteric fracture which I described (*Amer Jour Surg*, May, 1921), and it appears that the patient must fall slightly backwards, with all the weight thrown onto the injured hip, and must make a supreme muscular effort to catch herself by action of the external rotators of the thigh.

THE PROGNOSIS IN EPIPHYSEAL LINE FRACTURES*

BY MORRIS KELLOGG SMITH, M D
OF NEW YORK, N Y

THIS paper is a study of thirty-three cases of epiphyseal line fractures observed largely in the Out-patient Department, but to a certain extent in the wards of St Luke's Hospital. No case has been included which has not been followed and radiographed at least six months after injury. The inquiry, which was stimulated by the occurrence in a youth of premature ossification with resultant deformity after separation of the lower radial epiphysis, has been made with a view to determine the incidence of untoward sequelæ in these types of injuries. The literature contains numerous reports of cases where marked shortening has occurred after epiphyseal fracture. There is little which gives a definite basis for prognosis further than the common consent that unfortunate late results are infrequent.

Ollier¹ has shown that the epiphyseal cartilage is stimulated by trauma at a distance to increased activity, thus explaining the increase in length often observed in long bones after diaphyseal fracture, and on the other hand that when the cartilage itself is injured a retardation of growth takes place. Thus in young animals whose epiphyseal cartilages he traumatized by cutting and stabbing with needles, there was after three or four months a shortening of the affected bone proportional to the damage done. He also found an increase of thickness in the injured extremity. The shortening is due to a slowing of growth rather than premature ossification, but ossification takes place more promptly than on the uninjured side. In experimental epiphyseal separations Ollier found that if reduction was made, shortening, although present, was so slight that it could be disregarded. In the unreduced separations, however, there was considerable arrest of growth. He explains the lack of shortening after most separations by the fact that the fracture line ordinarily runs in the newly forming bone adjacent to the cartilage rather than through the cartilage itself. When the epiphyseal cartilage was ablated complete arrest of growth took place. Ablation of the juxta-epiphyseal portion of the diaphysis produces an arrest of growth greater than the length of bone removed but less than when the cartilage is destroyed.

Bruns² studied a series of epiphyseal separations which were observed directly either because compounded or at autopsy. Of sixty-one cases twenty-eight were pure separations, that is without accompanying diaphyseal fracture, of which only five showed separation in the cartilaginous substance itself. This indicates the relative resistance of the cartilage to injury.

To summarize experimentally, arrest of growth is proportional to the

* Read before the New York Surgical Society, November 28, 1923.

amount of direct injury to the cartilage, and ordinarily in epiphyseal separations the fracture line is found juxta-epiphyseal rather than in the cartilage itself

Poland³ in his extensive work, "Traumatic Separation of the Epiphyses," published just after the introduction of X-ray diagnosis, collected a large number of cases including fifty-six instances of arrest of development. Following him there has been a considerable literature on epiphyseal separation, and it was one of the subjects of discussion at the French Surgical Congress in 1904. Numerous instances of arrested growth have been reported. Of late years interest in this subject has been much less lively, judging by the lesser number of articles which have appeared.

Epiphyseal fractures are common injuries but it is my experience that unless they are looked for many will be classed as ordinary fractures and some, where the amount of separation is slight, will be considered sprains. In the present study I have included among epiphyseal line fractures, cases where the fracture runs into the epiphyseal line as well as separations. In more than half of this series the injury included fracture of the adjacent diaphysis.

The thirty-three cases are distributed as follows: Lower radial twelve, lower humeral ten, lower tibial four, upper humeral three, lower ulna two, and metacarpal two. In all large statistics the lower femoral epiphysis is reported as one of the most commonly separated, but as the source of this material is very largely out-patient lower extremity injuries, especially femoral, are not proportionally represented.

It is more satisfactory to consider these cases by region, rather than as a whole, as sequelæ vary depending on whether the epiphysis involved is the one from which active growth takes place. Shortening after epiphyseal injury may be the result of retarded function of the cartilage alone, or there may be premature ossification. From experimental data Ollier stated that shortening was due to retarded proliferation of the cartilage in which, however, ossification took place earlier than on the normal side. This is probably the fact in human injuries. I suspect that in cases of marked shortening, premature ossification will ordinarily be found. Retardation of growth may, however, persist without ossification until such time as it would naturally take place.

There were twelve cases of epiphyseal line fracture of the lower end of the radius, of these five showed shortening, three with premature or earlier ossification on the injured side. To date only one of them has sufficient deformity and disability to make him feel that he has had a bad result.⁴ In his case beginning ossification of the epiphysis was observed when first reexamined eight months after the injury. At the end of two years his radius was three-quarters of an inch shorter. A second case showed ossification of the radial epiphysis, prominence of the ulna head and three-eighths inch shortening in six months. He suffered no disability nor had he noted any deformity. As he is, however, only fifteen years of age it is probable that the difference in the

PROGNOSIS IN EPIPHYSEAL LINE FRACTURES

two wrists will become more marked. The third instance of earlier ossification is a boy who has been followed at intervals of six months, one year, one and one-half years and two and one-quarter years after injury. Only in the last observation was ossification noted on the injured side. The first examination showed a retardation of growth, which after one year increased little if any. At the last examination the head of the ulna was prominent, the radius measured one-half inch shorter than its fellow and inci-



FIG. 1a—Slight posterior separation of the lower radial epiphysis in a boy of thirteen.



FIG. 1b—Same ten months later. Note shortening of radius on injured side as indicated by relation to lower end of ulna.

dentally the ulna one-quarter inch shorter than that on the uninjured side. Function seemed perfect.

Of the two remaining cases of shortening one (Fig. 1) examined in ten months showed broadening of the wrist and prominence of the head of the ulna. Measurement of X-rays indicated slightly less than three-eighths inch shortening of the radius. Function was perfect and he and his mother considered the cure complete. The last patient examined seven months after injury showed clinically about three-eighths inch shortening. There was no deformity notable, the ulna being also somewhat retarded in growth and no disability.

The remaining seven cases have excellent anatomical and functional

results Of them, three on careful measurements of the X-rays had very slight retardation of growth, which in one instance seems to have been overcome in the course of one and one-half years

The prognosis must therefore be guarded in general in these injuries The question as to whether it can be made with any definiteness in the individual

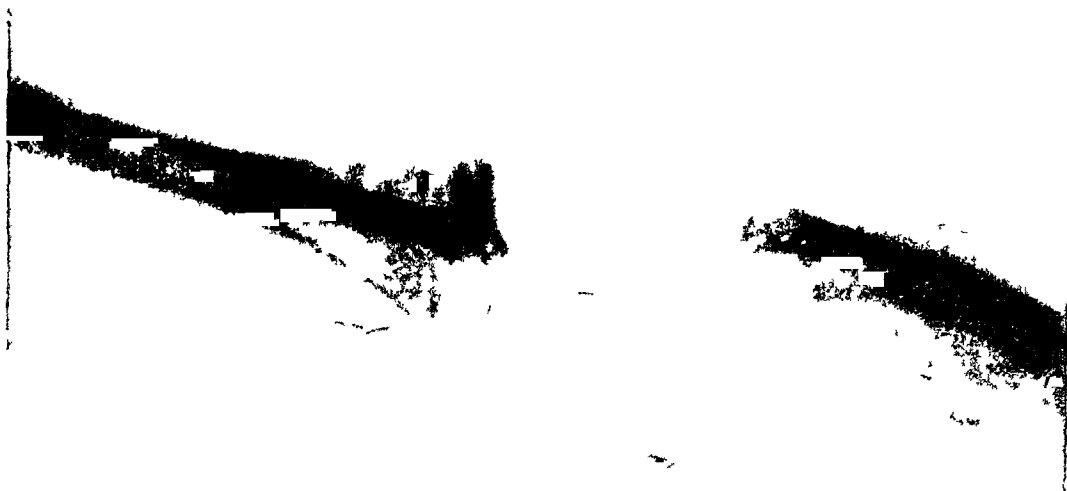


FIG 2—Separation of lower epiphysis of radius with marked displacement backwards of the epiphysis in a boy thirteen years of age A Radiograph taken two weeks after injury after an unsuccessful attempt at reduction B Radiograph taken sixteen months later showing almost complete correction of the deformity by nature Only the slightest retardation of radial growth can be made out

case is important This may be considered from the point of view of X-ray appearance of injury, extent of injury, reduction and age of patient

X-ray Appearance of Injury The question whether pure separations were more prone to sequelæ than separations associated with diaphyseal fracture was studied and both types found among retardations and non-retardations As far as prognosis goes there seems nothing to choose between these two types

In one instance there was a separation with fracture extending through the epiphyseal end of the bone into the joint Here it is hard to escape the conclusion that the cartilage itself was severely traumatized at least in

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one place. This case showed retardation of growth of one-half inch and ossification of the injured radius at the end of two and one-quarter years, while the corresponding epiphysis was unossified.

Extent of injury as shown by the original deformity does not seem to be any criterion of after result. Of the five patients who showed retardation, in two the original separation was so slight that no reduction was necessary.

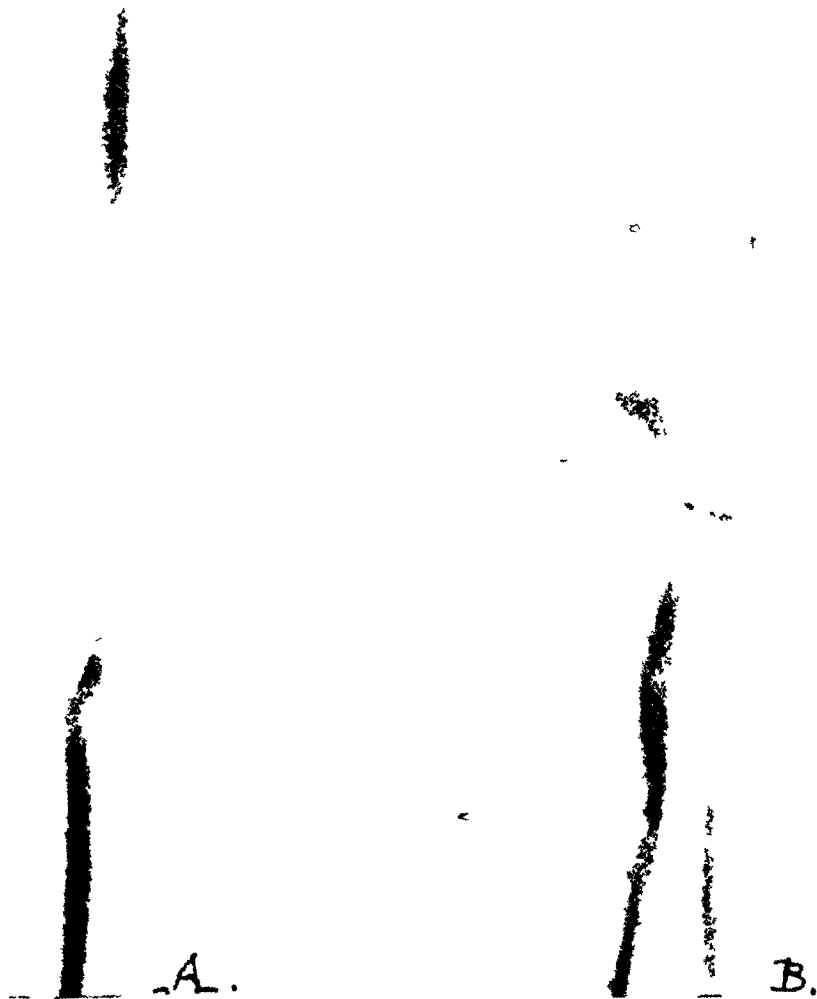


FIG. 3.—Fracture through external condyle of humerus into epiphysis in a girl aged nine years. A. Before reduction. B. After two and one-half years, note the premature ossification of the injured epiphysis.

This was the case in two of the seven who did not develop shortening. Massart and Cabouat relate a case in which after a fall there was epiphyseal injury at both wrists, on one side only with displacement. In this case reexamined at the end of three years there was shortening and radial deviation at the wrist on the side which originally showed no displacement, while the other wrist, originally with the more marked injury, appeared normal. A boy not included in this series came to the clinic with some complaint of his wrist. The ulna was prominent and the radius somewhat shortened. His history was that four years before he had injured the wrist. It was considered by his

doctor as a sprain and no X-ray taken. Undoubtedly many cases of so-called sprain are slight epiphyseal separations some of which may go on to deformity.

Reduction, as in any other fracture, should be accomplished if the injury is recent, although no guarantee of a good late result. On the other hand, in two of the cases (Fig 2) in whom the late result was excellent it was impossible to reduce a very decided silverfork deformity, as the patients did not apply until ten and fifteen days after injury. Clinically the deformity has been completely overcome in the course of about a year in both these patients. Another boy with a very marked separation, which radiographically was not



FIG 4—C Z age thirty-five years. In course of a general examination deformity of wrists noted. When about fifteen years of age, he hurt both wrists by a fall from a tree. X-ray shows shortening of both radii the result of epiphyseal injuries.

too satisfactorily reducible at the time, showed at the end of a year a splendid result.

Age Probably one reason why deformity and shortening are not more often observed after epiphyseal fractures is that they occur as a rule in the second decade when growth is perhaps largely completed. Of the twelve cases in this series only two were under ten years. The average age of the five exhibiting premature ossification and retardation is sixteen years as opposed to twelve years in those without sequelæ. It would seem from this that there is more liability to damage of the cartilage as the time for its function to cease approaches.

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There are four cases of lower tibial epiphyseal fracture of which two show retardation of growth, none premature ossification. Of the two showing retardation one aged thirteen, had a fracture through the epiphysis near the inner malleolus into the epiphyseal line. One year and nine months later the external condyle on the injured side appeared prominent and as if growing toward the sole of the foot. Measurements to the internal malleolus from the patella were one-half inch less on the injured side than on the uninjured. Measurements to the external malleoli were the same on both sides. The second, aged fourteen, had a separation of the epiphysis with supra-malleolar fracture of the fibula, requiring reduction. Two years later the internal condyle of the injured side appeared more prominent and higher than on the normal side. Measurement to internal malleolus was about three-eighths inch shorter than on the uninjured side; to external malleoli same on both sides. Neither of these boys had functional disability. The other two lower tibial cases fourteen and eleven respectively, after one and one-quarter and two and one-half years showed no ill effects. The original injury in the former case was slight separation at the inner end of the epiphyseal line and in the latter a small diaphyseal fracture extending downward to the epiphyseal line. With regard to the type of injury it is noteworthy that in the first case described which eventuated in retardation the fracture ran longitudinally through the bony epiphysis into the conjugal cartilage in a manner comparable to the lower radial case in which the bony epiphysis was split into the conjugal cartilage and which resulted in retardation and eventual early ossification.

There are three cases of upper humeral epiphyseal fracture. In the first of these a boy of sixteen, the diaphyseal end was displaced outward and upward. As efforts at reduction were unsuccessful I did an open operation without local fixation, however, and the deformity recurred. Examination two and one-half years later showed normal function except for slight limitation of internal rotation. Measurement, acromion to external condyle, showed one-quarter inch shortening on the injured side. Ossification had taken place on both sides. On the injured side the greater tuberosity reaches a higher level than the head due, undoubtedly, to union taking place with the head abducted. The shortening is due at least in part, if not altogether, to overriding of the fragments when union took place.

The second case, a girl of fifteen, applied two weeks after injury with a deformity similar in type to that of case one, but less marked, with union already present. No attempt at reduction was made. Fourteen months later clinically there was no deformity nor shortening. The X-ray shows a slight curvature in the upper end of the bone, and measurement of it indicates a little shortening on the injured side. The third case, a boy of thirteen, had a fracture through the surgical neck into the epiphyseal line, with a slight angulation. Sixteen months later he was perfectly restored clinically and radiographically. Of the three cases none can be cited as unquestionable examples of retardation of growth. In the first two cases the excellent functional results, in spite of uncorrected displacements, is noteworthy.

There are two cases of lower ulna epiphyseal fracture. Both of these had considerable separation associated with fracture of the lower one-fourth of the radius. In both primary reduction was satisfactory. One, aged fifteen, showed ossification in the injured ulna nine months after injury, and in sixteen months ossification of both bones of the injured side was completed while those of the uninjured side were well along. There was no shortening in this case. Functionally pronation was slightly limited. The second was thirteen at the time of injury. Two years later no difference could be made out in his wrists. Careful measurement of the radiograph showed very slight retardation of the injured ulna. Of these two cases ossification was stimulated in one, there was no notable shortening in either.

These four groups of injury of the actively growing epiphyses of long bones naturally fall into one larger group as follows:

	No. of cases	Retardation	Premature ossification †
Lower radius	12	5	3
Lower tibial	4	2	0
Upper humerus	3	0	0
Lower ulna	2	0	1
	—	—	—
Total	21	7	4

The lower humeral epiphyseal fractures should be considered apart from the previous group, as growth from this epiphysis is relatively slight, consequently retardation of growth does not have to be particularly reckoned with. In the follow-up X-ray studies broadening and alteration of outline of a condyle was frequently noted.

There were ten cases in this group of whom one was a dislocation inward of the lower epiphysis, with fracture of the internal condyle, one a separation of internal epicondyle with evidence of slight injury on capitellar end of epiphyseal line, five fractures of the external condyle extending into epiphyseal line, two complete outward dislocations of the capitellum, and one separation of internal epicondyle alone. The age of this group averages lower than that of the remainder—nine years plus.

One of the number (Fig. 3) examined two and one-half years after injury, showed premature ossification of the lower epiphysis. She was nine years old when hurt. X-ray showed a fracture of the external condyle and capitellar epiphyseal line extending into the epiphysis. Reduction was made under gas and the arm treated in acute flexion. At the follow-up, the

† It is doubtful whether to class the boy with the early ossification of the lower ulna epiphysis as premature ossification. In his case there has been no retardation of growth. Ossification, as shown by X-ray may not necessarily take place at exactly the same time in normal corresponding epiphyses. On the other hand in this case ossification seemed to be definitely stimulated in the injured wrist. I have one radiograph taken two years after lower radial epiphyseal injury in which the uninjured radial epiphysis is in process of ossification while that on the injured side showed no sign, although slightly retarded in growth.

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elbow seemed perfectly normal in appearance and function. Measurements of both arms were the same. The X-ray showed an apparent broadening and shortening of the external condyle as well as the premature ossification.

A second case, a boy of fourteen, who had a separation of the internal condyle and evidence of slight injury at the outer end of the capitellar line, showed after six months' ossification of the lower epiphysis on the injured side, while the line could still be seen on the uninjured side. At the end of a year ossification was complete on both sides. In this case it would seem that ossification was hastened by the injury (not rated as premature ossification).

Only one case showed a notable deformity, a girl aged eight who had an inward separation of the lower epiphysis with fracture of the internal condyle. Apparently it was never successfully reduced and she has a gunstock deformity with good function. Measurement from the acromion process to the external condyle showed one-half inch lengthening on the injured side.

All the rest have excellent results. In none was there shortening noted clinically.

Examination of the radiographs show evidence of growth alterations by apparent widening of the lower end of the humerus in several, slight lengthening in three, including the one just described, and retardation of growth of the external condyle in two. Besides the gunstock case those showing a slight lengthening were both instances of dislocation of the capitellum outward, requiring open operative reduction.

Both cases of separation of the internal epicondyle failed after one and two years respectively, of osseous union. This is characteristic of the majority of these cases according to Poland.¹ In both the epicondyle was displaced downward.

There remain two boys with epiphyseal fracture of a metacarpus, aged thirteen and six years. In both there was flexion of the head of the bone in each case resulting immediately in slight shortening which has remained unaltered through the follow-up period of more than a year. Neither has shown premature ossification.

During the time when this study was being made five cases of old epiphyseal injury, with growth alterations, three of lower radial, two of lower ulna, have been observed. In three of them there was marked deformity (Fig. 4). None of them have been included in this series.

Summary. Thirty-three cases of epiphyseal line injuries have been followed up. Of these there were twenty-eight boys and five girls. The average age was twelve years plus. Only eight were ten years or less, the majority of these being in the lower humeral group.

Fifteen per cent. showed premature or earlier ossification. This was found as promptly as six months after injury in one case and as late as two and one-quarter years in another.

Retardation of growth to a slight degree is common. It was present in thirty-three per cent. of twenty-one injuries to actively growing epiphyses.

of long bones There was decided deformity from shortening in two cases of the twenty-one, or about ten per cent

Retardation of growth may persist without premature ossification From a study of this series it appears that a retardation of growth is seldom compensated later In lower radial injury with retardation a lesser ulna retardation is often associated, with or without ulna fracture

There seems to be a marked tendency for natural correction or compensation of epiphyseal separations to take place in such as have not been reduced

REFERENCES

- ¹ Ollier, L *Regeneration des Os* Paris, Masson et Fils, 1867, pp 378-410
- ² Bruns, P *Ueber traumatische Epiphysentrennung* Archiv f klin Chir, 1882, vol xxvii, pp 240-264
- ³ Poland, J *Traumatic Separation of the Epiphyses* London, Smith, Elder and Company, 1898
- ⁴ Smith, M K *Premature Ossification after Separation of the Lower Radial Epiphysis* ANNALS OF SURGERY, 1922, vol lxxv, pp 501-3
- ⁵ Massart, R, and Cabouat, P *Les Lésions traumatiques du Poignet* Lyon Chir, 1923, vol xx, pp 67-88
- ⁶ Poland, J *Traumatic Separation of the Epiphyses* London, Smith, Elder and Company, 1898, p 377

SPINAL ANÆSTHESIA

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NORWITHSTANDING the uniformly good results obtained with spinal anæsthesia in the hands of experienced operators and the numerous advantages and relative safety of the method it is somewhat strange to note the reluctance of many surgeons in adopting its use. This reluctance is attributable to a number of factors to which we shall refer later. However, the review of the literature shows a slow but steady progress in the adoption of the method and although at present it is far from universally adopted, it would seem that the time is not far distant when spinal anæsthesia will be sanctioned by the entire profession and employed in appropriate cases by all surgeons. In our opinion, the method has a large and important field of usefulness and should therefore, be a part of the armamentarium of every surgeon. The careful recording and publication of results obtained with spinal anæsthesia in the hands of various operators will perhaps do more than any one thing in establishing the proper status of the method. It is with this idea in mind that we are submitting this brief account of our experience with spinal anæsthesia.

Our series includes 387 cases and covers a period of two years. Although we appreciate the fact that this is a comparatively small number of cases, it appears to us sufficient for a fair trial of the method and to permit some conclusions. Before proceeding with the report of our experience with spinal anæsthesia, a very brief resumé of the subject may be apropos.

Definition Spinal anæsthesia is the loss of sensation produced by the injection of anæsthetic drugs into the subarachnoid space. It is essentially a nerve block induced by the action of the drug on the sensory nerve roots within the subarachnoid space. We consider "subarachnoid analgesia" a more proper term than spinal anæsthesia.

Historical J. Leonard Corning, of New York, in 1888, injected solutions of cocaine between the spinous processes for the relief of pain in cases of spinal disease. He did not puncture the dura, but produced analgesia by injecting around the spinal nerve roots extradurally. Although this, in reality, was the method now termed paravertebral analgesia, it served to suggest the intra-dural injection of anæsthetizing solutions.

August Bier, of Bonn, in 1899, was the first to induce analgesia by the injection of cocaine into the subarachnoid space. He tried the method on his assistants and also acted as a subject himself. Later in the same year Tait performed the first operation in America with spinal anæsthesia. Fol-

lowing this, the procedure was adopted by quite a number of operators, but due to its unpleasant experiences was promptly abandoned by most of them. With cocaine there were numerous untoward effects and a number of deaths.

In 1903, Fournieu isolated stovaine, and in the following year Einhorn isolated novocain. With the discovery of these drugs, the method received a new impetus. The technic of induction was improved and spinal anæsthesia became a safe procedure. It has steadily gained in prominence, so that at present it is rather widely used. In many of the large European clinics, it is the method of choice. In this country, although there are numerous operators who have had extensive experience with the method and are enthusiastic with the results, its progress has been somewhat slow. Some of the factors which have retarded its adoption are

(1) Prejudice of those who have had no experience with the method. This prejudice appears to be based, firstly, upon a peculiar dread on the part of many physicians to puncture the spinal membranes. Fear of infection or paralysis seems to be the foundation of this dread. However, the harmlessness of spinal puncture as demonstrated by routine spinal fluid examinations in the syphilis clinics should remove any such dread of dural punctures, providing a simple yet careful aseptic and antiseptic technic is followed. In the last ten or fifteen years, we have performed lumbar punctures for diagnostic and therapeutic cases in between one and two thousand cases of lues without a death or complication. Secondly, fear of uncontrollable action of the anæsthetizing drug after injection also seems to be a prejudicial factor. This factor can only be removed by a thorough knowledge of the principles of spinal anæsthesia.

(2) Unsatisfactory and at times fatal results attending the use of the method in the hands of those who are careless or unfamiliar with the principles of spinal anæsthesia have also retarded its use.

(3) In some instances unpleasant results have been due to improper selection of patients.

Mechanism and Phenomenon of Spinal Anæsthesia The effects of spinal anæsthesia are those produced by the influence of the drug on the motor and sensory nerve roots within the subarachnoid space, on the cord itself, and its effects after absorption in the blood stream. Its influence on the cord is only slight, so that the conducting columns continue to function. The spinal nerve roots acted upon and resulting areas of the body anæsthetized depend upon the following factors:

- 1 Posture of the patient following injection
- 2 Specific gravity of anæsthetizing solution
- 3 Normal secretion, excretion and circulation of spinal fluid
- 4 Quantity of spinal fluid removed
- 5 Dosage of drug
- 6 Bulk of solution
- 7 Point of injection
- 8 Rapidity of injection

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Ordinarily providing there is no contra-indication, the injection is made with the patient in the sitting posture. The subsequent position of the patient is determined by the specific gravity of the solution injected. Babcock¹ uses a solution either much lighter or much heavier than spinal fluid with the idea of controlling the influence of the drug by the position of the patient. The specific gravity of spinal fluid ranges from 1.006 to 1.008. If the heavy solution containing lactose and which has a specific gravity of 1.020 is used, the head and shoulders of the patient are kept elevated, and if the light solution, containing absolute alcohol and with a specific gravity of 0.992 is used the head and shoulders of the patient are immediately placed in a position lower than the hips and retained in that position for at least one hour after injection. Such solutions rapidly find their level in the caudal portion of the subarachnoid space and the normal circulation of spinal fluid toward the periphery tends to keep the drug localized.

Labat² and others dissolve the anesthetizing drug in spinal fluid, thus producing a solution only slightly heavier than spinal fluid. After the injection of such a solution the patient is immediately placed in a position with the head and shoulders slightly elevated. Such a solution will diffuse downward below the point of injection and to a lesser degree upward. Its diffusion upward is obstructed to some extent by a downward circulation of spinal fluid. Passage of the anæsthetic drug into the venous circulation surrounding the spinal membranes begins immediately after the injection, being carried along with the spinal fluid. Within a few minutes (five to ten) the drug has diffused to its full extent and the patient may be put in the Trendelenburg position if this is desirable. The secretion, excretion and circulation of the cerebrospinal fluid play an important rôle in spinal anæsthesia. According to Boyd³ the fluid is continually being secreted by the epithelial cells covering the choroid plexus and to a certain extent originates from the perivascular spaces of the arachnoid mater. It is also continually passing from the subarachnoid space into the lymphatic system via the subarachnoid spaces along the cranial and spinal nerves. There is thus a continuous circulation of fluid, so that the total quantity which in man averages 120 c.c. is perhaps replaced four or five times in twenty-four hours. Thus crystalloid substances such as the drugs used in spinal anæsthesia upon being introduced into the subarachnoid space, rapidly find their way into the vascular circulation aided by the flow of spinal fluid.

The quantity of the spinal fluid removed prior to the injection of the anæsthetizing solution is also a matter of importance. If considerable fluid is removed, lowering the intraspinal tension, the anæsthetizing solution will diffuse more rapidly and more extensively than if no fluid or very little is removed. In general, it may be stated that the more fluid removed, the higher the anæsthetic.

The dosage or quantity of the drug used should be governed by the duration of analgesia required for the operation. One should use no more of the drug than is necessary. The bulk or quantity of solution injected is

also a factor for consideration. Ordinarily, the drug is dissolved in 2 c.c. of either distilled water or spinal fluid. If extensive diffusion of the drug in the subarachnoid space is desired, the solution may be further diluted with spinal fluid. When thus diluted the period of analgesia is shortened. If only a limited low area of analgesia is necessary, the 2 c.c. of solution is injected without further dilution. The point and rapidity of injection are factors concerned in the mechanism which will be discussed later.

The influence of the drug begins almost immediately after injection. First the areas of the body supplied by the segments at the point of injection are affected. Then as the drug diffuses, the action occurs in the areas supplied by the segments above and below the point of injection. As a rule, analgesia is complete within five minutes, and reaches its height of intensity in fifteen minutes. The effect is most marked and lasts longer in the areas supplied by the segments immediately around the point of injection. Just after injection, patients often experience a tingling, numbness, or other paræsthesia in the feet. Loss of sensation and motor paralysis then occurs and is usually complete in the lower extremities except in the small muscles in the toes and the iliopsoas. Occasionally, however, a patient will have complete analgesia and retain motor power. It appears that the anterior motor roots are less exposed and less sensitive to the drug than the posterior roots. Tactile sense is often retained when there is complete loss of pain sense.

Abdomen and Viscera The abdominal muscles are completely relaxed during spinal anæsthesia. Relaxation is more marked than during the deepest ether anæsthesia. The intestines and stomach are contracted and peristaltic movements are increased. This may be explained by the paralysis of the sympathetic nerve supply, which normally inhibits intestinal movements. The motor influence through the vagi is thus left unopposed.

Circulation The effect of spinal anæsthesia on the circulatory system depends upon the height reached by the drug in the subarachnoid space. If the action of the drug is confined to the lower spinal segments, little or no change in the circulatory system occurs. When the upper dorsal segments are involved, a slowing of the heart and a fall in blood-pressure occurs. The sympathetic nerve fibres which exert an accelerating influence on the heart leave the spinal cord *via* the anterior roots of the upper thoracic nerves, and when these are influenced by the drug, the vagi are left free to inhibit heart action. The blood-pressure is lowered by the drug acting on the vasomotors, which leave the anterior roots *via* the rami communicantes. Ordinarily, when the abdomen is anæsthetized, the pulse rate becomes ten to thirty per cent lower than before injection and the blood-pressure falls correspondingly. Occasionally, however, the blood-pressure will drop to a point where it cannot be accurately determined. Such patients require immediate stimulation and respond well to epinephrin, caffeine-sodium-benzoate and strychnia. Considerably less hemorrhage occurs with spinal anæsthesia than with ether or gas anæsthesia. There is also less tendency to post-operative hemorrhage.

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Respiration The amplitude and rate of respiration are unaffected if the anæsthetic effect is confined below the diaphragm. If the muscles of the thoracic walls are paralyzed, respiration becomes slow and shallow and the patient will complain of a sense of weight on his chest.

Genito-urinary Tract Careful urinalysis following spinal anæsthesia has failed to show any evidence of renal irritation. The vesical sphincters are not relaxed.

Skin The skin usually shows no changes during spinal anæsthesia. Occasionally, if the anæsthetic involves the upper dorsal region, the skin becomes pale. Toxic effects, or effects of the drug after absorption into the blood stream are discussed by some writers. Such symptoms as faintness, pallor, nausea, vomiting, dyspnoea are included by some authors as toxic symptoms. It would seem that these effects can be more readily explained by the direct action of the drug on the spinal nerve segments of the thoracic region. Convulsive attacks, lapse of consciousness and sudden cessation of respiration are probably due to the passage of a large dose of the drug into the general circulation.

Drugs Our experience has been limited to apothesine and novocain. However, we have made use of apothesine chiefly. The results obtained with both of these agents have been entirely satisfactory.

In the beginning of our work with spinal anæsthesia, we employed apothesine tablets. One tablet of apothesine (grams $1\frac{1}{4}$) was placed in a sterile test tube containing $2\frac{1}{4}$ c.c. of sterile distilled water or the same quantity of normal salt solution. If only a limited low area of analgesia was desired, salt solution was used. After covering the test tube with sterile gauze and dissolving the tablet, the solution was sterilized by boiling over a Bunsen flame for five minutes. Such solutions must be freshly prepared and used immediately. Although our results with such solutions were quite good, there were certain disadvantages with this method. The preparation was quite troublesome and time consuming and there was some danger of contamination.

At our request, Parke Davis and Company very kindly prepared sterile solutions of apothesine in ampoules according to the following formulas:

1. Apothesine 0.1 gm. Distilled water 2 c.c. Such a solution we found rapidly diffused over a wide area and about thirty per cent. of patients to whom this solution was administered were nauseated while on the operating table.

2. Apothesine 0.1 gm. Normal salt solution 2 c.c. This solution was quite satisfactory. Very few of the patients were nauseated while on the table after the injection of this solution.

3. Apothesine 0.1 gm. Absolute alcohol 0.2 c.c. Distilled water 1.8 c.c. Such a solution has a specific gravity much lower than that of spinal fluid and was intended for use in cases where the Trendelenburg position was desired. We employed this solution only in a few cases (five). All of the patients were nauseated, and in two, the analgesia was unsatisfactory. We, therefore, discontinued the use of this solution and were later advised by

chemists of Parke Davis and Company that apothesine is incompatible with alcohol

4 Apothesine 0.10 gm Lactose 0.10 gm Distilled water 2 c.c. Such a solution is much heavier than spinal fluid. In using this solution, the patient's head is kept elevated. We have injected this preparation in about 125 cases. The extent of diffusion can be readily controlled by the position of the patient when this solution is employed. This has been the most satisfactory solution in our experience.

Recently Parke Davis and Company have prepared for us apothesine powder 0.12 gm in 5 c.c. ampoules, which have been sterilized in the autoclave. The apothesine is dissolved in spinal fluid at the time of the operation. The results have been uniformly good with the use of the drug in this form, and we are now using it exclusively. We have found that different lots of ampoules containing solutions prepared according to the same formula vary considerably and each new lot requires careful testing. The use of the ampoules containing the drug in dry form obviates this difficulty. Another advantage is that the patient may be placed in any desired position after injection of the drug dissolved in patient's spinal fluid. We have also used novocain in the same manner with good results.

Technic and Management of Patient We have not used preliminary narcotization routinely. In a considerable proportion of patients we have found it unnecessary, especially in cases where the operation can be completed in a short time. If the proposed procedure requires considerable time and the temperament of the patient indicates, we administer morphia grain 1/6 and hyoscin gr. 1/100, three-quarters of an hour before operation.

The following apparatus is used. One 5 c.c. Luer syringe, 1 Babcock spinal puncture needle, 19 gauge, 1 Luer needle for aspiration of solution from ampoule, 1 file.

These are sterilized by boiling in distilled water without alkali and are brought directly to the operator.

The ampoules containing the drug are kept in a jar of seventy per cent alcohol.

Spinal puncture is more easily performed with the patient in the sitting posture. So that unless the patient is weak or presents some other contraindication, we make the injection with the patient seated across the operating table. The patient with arms crossed and back bowed forward and head and neck fully flexed is supported by an attendant. The back is painted over a wide area with three and one-half per cent tincture of iodine followed by alcohol.

Ordinarily injections through the lumbar spaces will suffice. Occasionally when employing a heavy anæsthetizing solution and desirous of a high field of analgesia, we have made the puncture between the tenth and eleventh or eleventh and twelfth dorsal vertebrae. Usually we select the space with the widest gap between the spinous processes, and in most cases this is the space between the third and fourth lumbar vertebrae. The point of the spinal

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puncture needle is then placed in the midline of the space selected, and after spraying ethyl chloride, it is introduced in the median line into the subarachnoid space

As stated above, we are now dissolving the drug in spinal fluid. After removing the stylet, 2 to 3 c.c. of spinal fluid is allowed to run into the ampoule containing apothesine. The drug rapidly dissolves and the solution is aspirated into the syringe. Ten to 25 c.c. of spinal fluid is allowed to escape into a tube. The quantity of fluid removed is determined by the pressure and the extent of analgesia desired. The syringe is then adjusted to the spinal puncture needle and enough spinal fluid aspirated into the syringe to make 5 c.c. is then slowly injected without force and about 1 c.c. withdrawn. This manoeuvre is repeated until the entire quantity of solution has been introduced. After removing the needle the patient is immediately placed in the prone position with head and shoulders elevated. With this method after fifteen minutes, he may with safety be placed in the Trendelenburg position.

In using the solution of the drug in water or salt solution the technic differs from the above in that only 2 to 3 c.c. of spinal fluid is removed.

The blood-pressure and pulse rate is noted before the injection and every five minutes after the injection. It has been our custom to administer five minims of 1:1000 adrenalin solution together with strychnia, grain 1/30 subcutaneously immediately after the subarachnoid injection. This is given with the idea of forestalling the fall in blood-pressure and slowing of the heart. If the blood-pressure falls to a marked degree, ten to fifteen minims of adrenalin solution is given intra-muscularly. Should a marked slowing of the pulse occur caffeine-sodium-benzoate, four grains, is given intra-muscularly. Strychnia is also a valuable stimulant in these cases. Elderly patients or patients with impaired myocardium often require stimulation. Sterile normal salt solution and apparatus for its administration intravenously should always be in readiness in the event of circulatory failure.

Untoward Effects—Nausea of a varying degree, either during or just after the operation, has been complained of by fifteen to twenty per cent of our patients. A slight pallor usually accompanies the nausea. Nausea occurs more frequently with the Trendelenburg position than when the head is kept elevated. This symptom is also more frequent with the use of analgesic drugs dissolved in water or salt solution than when the drug is dissolved in spinal fluid. About two-thirds of the patients who were nauseated also vomited. Nausea ordinarily lasts from thirty minutes to two hours.

Three of four patients complained of a sense of weight on the chest. Respiratory movements were shallow, sighing and eight to twelve a minute in these cases. This condition passed off in a few minutes. Rebreathing through a closed inhaler is helpful in this condition.

Syncope following the subarachnoid injection occurred once in our series. This patient, a male, age sixty-two, with rather marked myocardial degeneration and advanced nephritis, and whom we considered a better risk with spinal anæsthesia than with inhalation anæsthesia, lapsed into unconsciousness five

minutes after the injection. The pulse could not be felt at the wrist and respirations were slow and shallow. Salt solution with adrenalin added was immediately administered intravenously. He was also given caffeine and strychnia. After about five minutes, he regained consciousness. Respiration and heart action promptly returned to a satisfactory condition, and no further difficulties arose. This is the only patient whose condition was alarming while on the table.

In this series there have been no deaths due to the anæsthesia. Only one patient died soon after operation. This case of extravasation of urine in an elderly male admitted to the hospital and operated on when in an obviously moribund condition died eight hours after the operation.

Headache of the spinal type, accompanied by stiffness of the neck muscles, was recorded in eight of our cases. This usually came on several days after operation and none persisted more than ten days. Such headaches are only slightly relieved by the usual remedies. These patients are quite comfortable while lying down and experience pain only when in the erect posture. About fifteen per cent of patients complained of headache of mild degree and lasting about a day. We have not observed a single case of spinal headache following the injection of the drug dissolved in spinal fluid.

Slight backache lasting a few days was complained of by twelve per cent of patients.

Temporary paralysis of the external rectus of the eye occurred in one of our cases. This condition appeared eight days after injection and completely disappeared in four weeks. In this case, a solution prepared by dissolving a tablet in water was used. The solution was probably contaminated.

The above are the only untoward effects which occurred in this series, and we feel that these would compare very favorably with the same number of similar cases operated with any form of inhalation anæsthesia. Disagreeable symptoms occurred more frequently in our earlier cases due to our inexperience with the method and also due to the use of various solutions and technics which we were employing in our effort to find the most satisfactory method.

Failure to Obtain Analgesia. Complete failure of the analgesia occurred in six of our cases. In four cases, failure was attributable to the solution. In the other two cases, although spinal fluid was withdrawn, the flange of the needle was probably only partially within the subarachnoid space and extradural leakage of the solution occurred. These cases could have been reinjected, but we preferred to use some other anæsthetic. Imperfect analgesia, but not requiring any other anæsthetic agent, occurred in fifteen cases.

Post-operative Care. Patients operated with this method require much less post-operative attention than patients operated with inhalation anæsthesia. The analgesic effect disappears quite gradually and pain is much less severe than following inhalation anæsthesia. The patients are quite comfortable and ordinarily appear little disturbed by the operative procedure. Abdominal distention is much less than with inhalation methods. Water may be given freely during and after the anæsthetic. It is our custom to allow only liquids

SPINAL ANÆSTHESIA

for at least four hours after operation, and then begin feeding according to the surgical condition present

If a heavy solution or drug dissolved in spinal fluid has been used, the patient may be placed in the Fowler position immediately upon returning to bed. Patients not requiring this position are placed in bed with one pillow under the head and are not allowed to sit up for at least thirty-six hours. If a solution lighter than spinal fluid has been given, the head should be kept lower than the hips until after the analgesic effect has disappeared. Patients should of course, be carefully watched until motor power of the lower extremities has returned.

Scope of Usefulness Spinal anaesthesia may be used with patients of all ages. Although we have had no experience with the method in children, it is stated by numerous writers that it is very satisfactory. It is particularly useful for operative procedures on elderly subjects such as those requiring prostatectomy. Our eldest patient was a physician, age eighty-two, who although a bad risk on account of cardio-renal and pulmonary disturbances, promptly recovered from a prostatectomy.

It is quite safe to induce analgesia affecting the body as high as the nipples, so that the method is suitable for practically all operations below this point. With the exception of cases suitable for other forms of nerve block analgesia, it is the method of choice in all cases presenting pulmonary, cardiac, renal and vascular disturbances. It is also a valuable method in operating diabetic patients.

We have administered spinal anaesthesia for the performance of the following types of operations: Nephrectomy and the various operations on the kidneys, suprapubic cystotomy, prostatectomy, amputation of penis, plastic operations on the penis, circumcision (cases with irreducible phimosis or otherwise unsuitable for local anaesthesia), epididymectomy, orchidectomy, external urethrotomy, appendectomy, cholecystectomy, herniorrhaphy (inguinal and umbilical), hysterectomy, and other pelvic gynecological operations, perineorrhaphy, reduction and plating of fractures of femur and tibia, amputations of lower extremities and hemorrhoidectomy. The great majority of cases were urological and were performed by us at the Colonial Hospital, and a few at the Mercy Hospital. The gynecological and some of the general surgical operations were performed by our associates for whom one of us gave the injections.

Selection of Patients and Contra-indications Quite needless to say, patients should be carefully examined before administering spinal anaesthesia. Particular attention should be directed toward ascertaining the condition of the myocardium and the blood-pressure should be recorded. Patients presenting marked myocardial degeneration may not tolerate the slowing of the pulse and drop in blood-pressure following the subarachnoid injection. Patients with a low blood-pressure, *viz.*, below 100 systolic, may likewise do badly with spinal anaesthesia. Cases with pericardial or pleural effusions are also poor risks. However, if such patients are also unsuitable for other forms

of anæsthesia, the subarachnoid injection may be made just after the hypodermic injection of strychnia, grain 1/30, and adrenalin chloride solution 1 1000 minims X This together with caffeine-sodium-benzoate may be repeated if necessary In such cases, one should be particularly careful to produce an area of analgesia just high enough to allow the performance of the proposed operation

Spinal anæsthesia should be avoided in operating patients with recent untreated syphilis

Valvular heart disease, unless associated with decompensation, is not a contra-indication Patients with hypertension are quite satisfactory for spinal anæsthesia

Conclusions In our experience with 387 cases operated with spinal anæsthesia, we have noted the following advantages of the method:

The anæsthetic is quickly and, in most cases, readily induced

Operative shock is avoided by the blocking of the nerve supply of the operating field

Hæmorrhage is less than with inhalation anæsthesia

Perfect muscular relaxation is a decided advantage in abdominal surgery A smaller incision may be made and less traction is necessary than with inhalation or local anæsthesia

Contraction of the intestines allows ready inspection of the abdominal viscera and very little packing off is required

The time allowed by spinal anæsthesia is conducive to more careful work

No injury to the kidneys occurs with spinal anæsthesia

The heart is disturbed less than with inhalation anæsthesia

Gastric disturbances occur in only a small percentage of cases and are then slight and transitory Liquids may be administered by mouth during and immediately after operation Nourishment may be given just after the disappearance of the analgesia effect

Convalescence is shortened and there are few post-operative complications attributable to the anæsthetic No lasting post-operative effects due to the anæsthetic have occurred in our cases

Spinal anæsthesia is a safe method as regards danger to life

In brief, spinal anæsthesia is a method which permits the performance of operative procedures without disturbing the equilibrium of the patient

REFERENCES

- ¹ Babcock Oxford Surgery
- ² Labat Regional Anæsthesia
- ³ Boyd The Cerebrospinal Fluid

TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting Held November 5 1923

The President DR JOHN H JOHNSON, in the Chair

TREATMENT OF ACUTE TRAUMATIC SYNOVITIS

DR HUBERT R OWEN said that during the past year, since reading the article by Williams which appeared in December, 1922, on the effect in the treatment of acute traumatic synovitis of repeated aspirations and immediate active mobilization without splinting, he had treated eleven cases by the method described. Such cases presenting hæmarthrosis and hydarthrosis, are usually treated by rest, splints, plaster-of-Paris, etc. In the recent cases which he had subjected to aspirations he had found the period of disability to be greatly diminished practically to two-thirds of the time it would take by the fixation and plaster-of-Paris treatment. It also greatly relieves the immediate pain and the distention in the joint. He aspirated twenty-two times and the average time of treatment was twenty-four days from time treatment was started until the man was back on duty. In looking up similar cases treated by the fixation method, he found the aspiration method took just about two-thirds as long.

PERICARDIOTOMY FOR SUPPURATIVE PERICARDITIS

DR J W BRANSFIELD presented a youth, aged eighteen years, who was admitted to St Agnes' Hospital, July 8 1923 complaining of difficulty in breathing and pain in left chest. Two days before admission he was stabbed with sharp pointed scissors in left chest. States he has had shortness of breath since this accident and severe pain on breathing. Examination shows an abscess over the ninth rib in the nipple line. Patient is very nervous and irritable and complains of pain wherever he is touched. During the following day abscess opened. Two ounces of pus evacuated. Patient feels better, but shortness of breath continues. Dulness found from seventh rib to base of lung in axilla. X-ray report: Pericardial shadow enlarged. Has appearance of fluid present. Diaphragm moves freely on both sides. Erosion of bone tenth cartilage.

On July 16, under local anaesthesia, the fourth rib was resected close to sternum. pericardium opened and only one ounce of fluid obtained. fluid cultured staphylococcus aureus reported from the laboratory. Patient sent to X-ray fluoroscope made and stereoscopic plates. No doubt of fact pericardium greatly distended. Fluid was suspected lower and posterior so under a general anaesthetic the fifth and

sixth cartilages were resected, the pericardium was brought up into the wound and incised. About one-half pint of fluid escaped. Culture showed staphylococcus aureus again. Patient was dressed daily and the opening maintained. Drainage was continued for two weeks. The pericardium was irrigated with normal salt solution daily. After this the wound was dressed with Dakin's oil and one ounce of oil was poured into the pericardial sac. Convalescence was stormy because the patient was hard to manage. Temperature varied from 100 to 104 for the first three weeks. After the fourth week the temperature became normal and the patient was allowed out of bed after the fifth week. Examinations made of the patient since, at three weeks' intervals have failed to reveal any heart disturbance. The patient has no cardiac involvement and is able to do his regular work. Recent X-ray pictures show the pericardial sac of normal size.

DR JOHN B. ROBERTS remarked that in suppurative pericarditis it is generally unnecessary to excise the costal cartilages. The same thing is true in pleural suppuration. A horizontal incision in the fourth or fifth interspace will usually afford room for drainage and irrigation without cutting away a rib or costal section. Even in young children resection must rarely be necessary. The vertical incision of Pool is perhaps occasionally required, but the accompanying removal of cartilage requires more time and is more serious. With a good open incision between ribs one can push the pleura to one side by blunt dissection. Of course when pus is coming out of the pericardium, one can understand the fear of pus escaping into the pleural sac, but just as good work can usually be done without mutilating the cartilages as is done in the vertical para-sternal cut.

As to the X-ray diagnosis of pericardial effusions, he related an experience at the Polyclinic Hospital a few years previously when a child, seven and one-half years of age, was admitted and declared to have a large effusion. The X-ray showed definitely, it was declared, that there was an extensive effusion in the pericardium, confirming the diagnosis made by the pædiatrician. Doctor McKnight punctured between the xiphoid and seventh cartilage with an ordinary aspirating needle and obtained no fluid. An incision in the fourth interspace of about three inches long between the cartilages of the ribs enabled him to introduce a finger into the pericardial sac, where he found no fluid, but only a large hypertrophied heart. The X-ray diagnosis was incorrect as was the clinical diagnosis made at first, namely, effusion, as there was none present. This seems to show that one must not take the laboratory findings as final, even of the best men. One must also obtain a careful history and translate the clinical symptoms.

After operation, the child immediately began to improve. The revised diagnosis of valvular disease and secondary hypertrophy led to a change in medical treatment. The splitting of the pericardium, by giving the enlarged heart room, probably was an additional reason for this improvement. The child got practically well and had his tonsils removed before leaving the

PERICARDIOTOMY FOR SUPPURATIVE PERICARDITIS

hospital. A subsequent report showed him running around and in fair health. No harm had come from either aspiration or the correction of the diagnosis by freely opening the pericardium for revising the diagnosis of the exact pathological condition. The horizontal incision in the fifth or sixth interspace gives plenty of room for introducing the finger. The division of the internal mammary vessels may easily be controlled by clamping with a hæmostatic forceps, which in this case was left protruding from the wound for a couple of days.

DR D. L. DESPARD remarked concerning the taking away of one cartilage that in his case he found that the pleura was not confined to the anatomical description given in the text-books but came well over to the sternal line. However, this particular pleura had fluid in it and if he had gone through one incision he would have gone through the pleura and infected it. There is better control by the vertical incision of the anatomical relations and he did not believe there is serious disadvantage in the more extensive removal of the cartilages.

DOCTOR DESPARD then presented a heart removed from a man on whom he operated last summer with a history that he had been taken ill three months prior to admission to the hospital with bronchitis or bronchopneumonia. He was in bed for one week and then went back to work, but after three days had to give up his position and did not work again up until his admission to the hospital two and one-half months afterwards. The X-ray showed tremendous dilatation of the pericardium. He was operated on under local anaesthesia. The pericardium was opened and drained and Dakin's tubes inserted in place. Two or three days later his temperature began to go up and he got gradually worse and died. The autopsy showed first, chronic suppurative pericarditis, second, old operative wound, third, chronic adhesive pleuritis, bilateral, fourth, general pulmonary tuberculosis, fifth, tuberculous lymphadenitis peribronchial, sixth, parenchymatous degeneration of the liver, seventh, chronic diffuse nephritis.

The incision was from above at the fourth cartilage and the left side of the sternum, and downward along the left side of the sternum to the seventh costal cartilage, removing fifth, sixth and seventh costal cartilages under local anaesthesia. Exposure was good. Tube placed to the bottom of the sac. The man did not seem to mind the operation and stated that "anyone could stand the operation."

DR JOHN H. JOPSON said that Pool's argument in favor of the resection of the fifth, sixth and seventh cartilages was that in this way one could reach the bottom of the sac with Dakin's solution, and it would not accumulate. He had had one case in which he used the old-fashioned method of resecting only one costal cartilage and found that the administration of Dakin's solution was not very successful. The fluid puddled too much. In similar cases he would use the vertical incision and in this case one should remove the fourth, fifth and sixth, or the fifth, sixth and seventh cartilages to get down to the base of the pericardium.

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INTRA-ABDOMINAL HEMORRHAGE FROM RUPTURED CORPUS LUTEUM

DR DAMON B PFEIFFER related the history of a girl aged fifteen and one-half years, who was wakened at 2 A.M. by severe abdominal pain. The pain was general and continued with but little abatement during the night and the following morning. The pain did not distinctly localize except that it seemed to be chiefly in the lower abdomen. This was the first attack of the kind. She had always been healthy and had had no digestive disturbances. She had begun to menstruate two years previously, had always been regular, the periods lasting four to five days and being normal in character. The last period was as usual, two weeks before the present attack.

On admission to the Abington Hospital, February 14, 1923, she appeared rather pale, but she was a pronounced blonde and her skin was usually white. The conjunctiva was not markedly blanched. General examination was negative. The temperature was 97, the pulse 72, and respirations 20 per minute. She still complained of abdominal pain. The abdomen was moderately distended and there was tenderness and moderate rigidity in the right lower quadrant and, to some extent, on the left side over the pelvis. The leucocyte count was 17,600.

She had been very active and athletic, engaging strenuously in basketball. Several days previously she had been knocked over a chair, striking her abdomen violently but the resulting pain soon stopped. The evening of the attack she attended a dance but had no pain, and was in bed at 12 o'clock. No pelvic examination was made because of her age and the absence of symptoms pointing in that direction.

At operation as soon as the peritoneum was reached the blue color betrayed the presence of blood. On incising the membrane fluid blood poured out in abundance. The right ovary appeared slightly larger than normal and on its convex border there was an irregular rupture about 5 cm. in diameter, exposing the interior of a small cyst from which blood was slowly oozing. The left tube and ovary were examined and found normal. As the cyst did not appear enucleable the ovary was removed. The appendix was amputated. Clots in the pelvis were withdrawn by hand and the abdomen closed without removing the bulk of the fluid blood, estimated to be about a litre.

Recovery was uneventful. The blood count the day after operation was Hæmoglobin 80 per cent, red blood cells 4,090,000, white blood cells 12,200, on February 26th the blood count was Hæmoglobin 89 per cent, red blood cells 4,580,000, white blood cells 7100. Her health has been perfect and menstruation normal since leaving the hospital.

Microscopical examination of the ovary showed a cyst about 2 cm. in diameter after hardening and preparation, the lining of which was made up of lutein cells undergoing retrogressive changes. This mantle of cells varied greatly in thickness being thinnest on the convex border near the point of rupture. Beneath the theca there were a number of interstitial hemorrhages. The ovarian stroma appeared rather loose and oedematous and in some areas there were a few scattered lymphoid cells, but not sufficient to justify the diagnosis of chronic inflammation.

INTRA-ABDOMINAL HÆMORRHAGE

The reporter added that this is a rare accident although its existence has been known ever since Scanzoni in 1845 reported the case of a young girl aged eighteen who died of hemorrhage from rupture of a small ovarian cyst, the abdomen containing six pints of blood. In the absence of a microscopical examination, some doubt has been cast on this case as being probably an instance of ovarian pregnancy. However, since that time a considerable number of authentic and thoroughly studied cases have been put on record and it has been proved that grave and even fatal hemorrhage may occur as a result of rupture of an ovarian cyst in the absence of pregnancy. Von Beust in Germany, Jayle in France, Novak, Richard Smith and Bovee in this country have made the most complete studies and collective reports of the condition.

Ovarian hæmatomata are of four varieties: (1) Interstitial in which hemorrhage occurs into the stroma, a rare variety and probably not productive of massive intra-abdominal hemorrhage by rupture. (2) Follicular which are sub-divided again into (a) Graafian follicle cysts and (b) atretic follicle cysts. It is well established that hemorrhage may occur into cysts of this variety and occasionally by subsequent rupture give rise to intraperitoneal hemorrhage. Collective reports seem to show that the more common variety is that of hemorrhage from atretic follicles. (3) Corpus luteum hæmatomata are relatively common findings in the ovary. The vascularity of the corpus luteum and the delicacy of its lining membrane would appear to predispose to hemorrhage into its interior. Occasionally the wall of the cyst itself ruptures during the stage of involution, followed by outpouring of more or less blood into the abdominal cavity. (4) The fourth variety of blood-containing cysts of the ovary is that which has recently been so brilliantly elucidated by Sampson of Albany, namely "The Perforative Hemorrhagic Cyst of the Ovary," which he has shown to be adenomas of the endometrium. These structures are in reality ectopic uteri and their contents are the result of menstruation carried on by the endometrial lining. They have long been known as chocolate cysts on account of the color of their contents and Sampson has pointed out their peculiarity of discharging at the height of the menstrual cycle bits of their adenomatous lining which have the power to engraft themselves on the peritoneum, thereby giving rise to secondary adenomas of similar behavior. No such cyst has been connected with massive intraperitoneal hemorrhage as yet, though there is no apparent reason why their penchant for rupture should not occasionally be the starting-point for hemorrhage of some magnitude.

Most of these cases have come to operation under the diagnosis of acute appendicitis. While it is quite possible that the great majority would recover without operation, the extreme difficulty of making a positive diagnosis without operation and the danger of overlooking a more serious condition make expectant treatment inadvisable. Treatment consists in either resection of the cyst or removal of the ovary. It is important to recognize the fact

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that massive abdominal hemorrhage may arise from the ovary independent of ectopic pregnancy

DOCTOR MULLER said that he could recall four or five cases in which there had been diagnosed a rather mild type of appendicitis and in which small clots of blood were found in the pelvis without any disease of the appendix. They might have been cases of corpus luteum origin. He also related the history of a woman who had symptoms of extrauterine pregnancy and was operated on in March, 1910, and the right tube removed for extrauterine pregnancy. In October, of the same year, she had the same symptoms, etc., and the same diagnosis was made by her physician. At operation the tube was found normal but the ovary showed a small perforation and there were three or four ounces of blood in the pelvis. The ovary was twisted and although they searched for it they could find no evidence of pregnancy in the ovarian tissues. Ten years later he removed the left ovary for a cyst five or six inches in diameter, showing that probably the original diagnosis should have been cyst

TREATMENT OF FRACTURES OF THE SKULL

DR HENRY P BROWN then read a paper with the above title, based upon one hundred cases observed at the Pennsylvania Hospital. Dr Edward A Strecker had collaborated with him in the preparation of this memoir. For this paper, see page 198

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting Held October 21, 1923

The President, DR. EUGENE H. POOL, in the Chair

CARCINOMA OF STOMACH

DR. ALLEN O. WHIPPLE presented a man, forty-five years of age, who for two years had suffered from attacks of vomiting, of gradually increasing frequency vomitus mucous and green colored, but never any blood or coffee-ground material. There was no loss of appetite nor marked loss of weight, nor absence of free HCl. He has had gradually increasing pain. He was admitted to the Presbyterian Hospital in December, 1920.

Test meals show pyloric obstruction, free HCl and no lactic. These facts, together with his florid color, lack of cachectic look and his generally good condition in presence of pyloric obstruction, suggested a pyloric ulcer causing obstruction.

Operation, December 28, 1920. Pylorectomy. Gastro-enterostomy, Polya-Balfour method.

Situated in the pylorus and occupying the upper and posterior half of the pylorus was an indurated mass causing partial obstruction. The mass measured approximately three centimetres in diameter. The serous surface showed one or two whitish plaques but otherwise the mass did not have the appearance of carcinoma. Lymph-nodes were not enlarged along the lesser or greater curvatures—only one or two small nodes were felt, below the pylorus between the duodenum and pancreas. No masses were noted in the gastro-hepatic omentum or in the liver. Inasmuch as the pylorus was not adherent to any structure, pylorectomy was indicated. The pylorus and a portion of the stomach a distance of 6 cm. from the pylorus was excised and then a loop of jejunum some 15 to 16 inches from the duodeno-jejunal angle was brought up in front of the colon and a side-to-end anastomosis was made between the anti-mesenteric border of the jejunum and the cut end of the stomach. This was done by serous peritoneal suture of shoemaker stitch changed to inverting Connel stitch with a continuation of the serous suture. Chromic was used throughout. The upper end of the jejunum was tacked to the gastro-hepatic omentum to prevent angulation of the upper end of the anastomosis. The pathological diagnosis of carcinoma of stomach was established.

Partial obstruction followed the operation but was somewhat relieved by giving him small meals more frequently. He gained weight and his emaciation noticeably improved.

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DOCTOR WHIPPLE presented a second case, a man aged sixty years, occupation laborer, who until one year before coming to the hospital had never been seriously ill. One year before admission he began to have epigastric distress after meals, 1 to 3 hours p.c. This distress was never severe, and was usually relieved by taking food. During the year he had vomited three times, never any great amount, and vomitus never contained blood or coffee-ground material. He had good appetite, had not lost weight and had no asthenia. Gastric analysis on three tests showed no free HCl. Trace of blood in both fasting and test meal contents. Barium fluoroscopy and X-rays showed a constant and large deformity on greater curvature of stomach, extending half-way through the stomach, showing absence of peristaltic wave. No six-hour retention.

At operation, March 19, 1921, corresponding to the incisure seen in the X-ray was found a dense hard mass, infiltrating the walls of the stomach. Lymph-nodes in lower part of the lesser part of the lesser curvature were enlarged, as were two near the site of deformity in the greater curvature. The stomach felt entirely free of pancreatic attachment, but after the duodenum had been severed and pylorus turned back, it was found that there was an attachment of the mass to the mesocolon, requiring the excision of a section of mesentery near the midcolic vessels. No liver involvement was found.

Partial gastrectomy was done, with gastro-jejunostomy, side of jejunum to end of stomach, jeuno-jejunostomy, Moynihan technic.

He made a very smooth convalescence. No vomiting, but it was evident he had a lessened stomach capacity below the average. Weight on leaving the hospital, 131 pounds. Two months follow-up, 143 pounds. No gastric symptoms. Nine months follow-up, 146 pounds. No gastric symptoms. Twenty-two months follow-up, 143 pounds. Shows beginning epigastric hernia.

DR. GEORGE WOOLSEY referred to a recent case of a Polya-Balfour resection of the stomach for carcinoma, where he was compelled subsequently to add jeuno-jejunostomy. He agreed with Doctor Whipple that jeuno-jejunostomy was often a wise procedure to add to the anterior operation. He was inclined, if conditions were favorable to do a posterior gastro-enterostomy, but where there was some special reason for an anterior gastro-enterostomy the jeuno-jejunostomy was often a wise proceeding.

DR. NATHAN W. GREEN said that cases of carcinoma of the stomach at the Memorial Hospital in the last three years—approximately 100, had been seen by him. They had come so late for treatment that little could be done for them. The point of value was that he was able to go into the histories formulating the symptoms of carcinoma of the stomach. It seemed to him that a large number of them gave a history chiefly of weakness. They did not stress the anorexia nor was the loss of weight always predominant, but the weakness was a main feature. Some of these stomachs had been resected before going to him, one, three and one-half years previously. This had a good-sized recurrence. This showed they might go on for quite

POLYSEROSITIS

a while without obstruction, yet what might seem a cure at the end of three years might show a palpable growth again at the end of three and one-half years. Doctor Green had been struck with the incidence of bad teeth, pyorrhea was almost universally present in these cases.

DOCTOR WHIPPLE said that there was a point which he had intended to bring out in regard to the two cases. Many of these patients with upper abdominal incisions, especially with post-operative pulmonary complications, have a tendency to hernia and this tendency has been eliminated in the past two years by using silkworm gut sutures on pearl buttons, a procedure first indicated in Doctor Bevan's clinic in Chicago. These tension sutures can be left in, twelve to fourteen days without the pressure necrosis which accompanies the use of silkworm gut sutures without buttons.

POLYSEROSITIS

DR CHARLES E. FARR presented a man thirty-three years of age, who was in the New York Hospital service of Doctor Gibson, from July 9 to 19, 1923 for acute intestinal obstruction, and chronic general peritonitis. He had been operated upon one and one-quarter years previously for appendicitis, this had been followed by left phlebitis, left leg and foot swollen. He had been suffering for four hours with severe pain and nausea and had had some constipation and indigestion with some vomiting for the previous two weeks. Physical examination showed a rigid, tender abdomen especially in the epigastric region. The abdomen was opened through the right rectus. Extreme obliteration of the peritoneal cavity was seen. The liver, gall-bladder, stomach and large bowel were in one dense mass of adhesions which were partially freed but with difficulty. No other lesion was found here. In the lower central abdomen a small free peritoneal cavity about 5 inches in diameter was entered. In this lay a sausage-shaped mass, at first mistaken for a mesenteric cyst. It was partly delivered and proved to be the entire ileum tucked into a skin-like covering, not unlike a sausage skin. This was split, partly resected and the loop of bowel freed with great difficulty. The whole operation was difficult and lasted about one hour. No drainage was used. Post-operative recovery was uneventful, although an absolutely bad prognosis had been given.

All clinical tests for lues or tuberculosis are negative. Improvement has continued. The X-ray with barium meal demonstrates a very fair peristalsis. The roentgenograms of the chest reveal an apparent destruction of the pleural cavities and possibly the pericardium. An attempt at artificial pneumothorax might clear up this point. The official diagnosis from the roentgenologist is tuberculosis of the mediastinal lymph-nodes and infiltration of both upper lobes.

These cases are usually rapidly progressive and prove fatal in a comparatively short time. Further progress in this case will be of great interest. The condition was thoroughly discussed by Charles N. Dowd at a meeting of this Society last spring, and his article in the *ANNALS OF SURGERY* for April, 1923, p. 432, is the most recent and authoritative on the subject.

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DR ALLEN O WHIPPLE spoke of a patient who is now in the Presbyterian Hospital. She was first operated upon four years ago for a condition which was then diagnosed as cirrhosis, considered at that time to be atypical. On opening the abdomen at that time, a considerable amount of fluid was found, and the peritoneum was thickened over the liver and spleen. An omentopexy was done. In the past four years the patient had been tapped twenty-seven times. She came back to the hospital in the early part of the summer, and on introducing a needle through the abdominal wall, it was noted that the fluid removed was purulent and foul smelling. A diagnosis of peritonitis was made, and she was operated upon immediately. The pathology noted at operation was very remarkable. The entire peritoneal cavity was made up of loculated spaces separated by a thin wall of peritoneum containing different types of fluid. In other parts the peritoneum was markedly thickened and showed the pathology of chronic productive peritonitis described by Welsh in 1908. She continued to improve and the sinus is now closed. With such extensive peritoneal inflammation, the function of her digestive apparatus is remarkably good. This further illustrates the lack of absorption in these cases of chronic productive peritonitis. This lack of absorption and good digestive function has been noted by a number of observers in these cases of chronic productive peritonitis.

DR EDWIN BEER thought there was a question as to whether this was a case of polyserositis for only one membrane was involved. Personally, he thought it should be called chronic productive peritonitis, and unless further information concerning the previous appendicitis was at hand, one could not exclude this as a cause of the productive peritonitis. As for the treatment by X-ray, it was very doubtful whether this would lead to absorption as it usually had the opposite effect within the abdomen.

DOCTOR FARR, in closing the discussion, said that when the appendix was removed the wound had closed primarily, there were many adhesions at that time. He had not cared to inject air into the pleural cavity. There almost surely is a destructive process in pleural sacs. There is no proof of the condition of this patient. The X-raying had been done as a last resort as nothing was being accomplished otherwise. Recent barium meal roentgenograms show a moderate distortion of the stomach with fixation of the pylorus. Emptying time is nearly normal and the passage to the colon seems slightly, if at all, delayed. The ileum throws a nearly normal shadow. There is some fixation of the ascending colon and slight stasis in the jejunum. The patient is slowly gaining in weight and strength.

SUPPURATIVE ARTHRITIS OF KNEE

DR CHARLES E FARR presented three cases of acute suppurative arthritis of the knee, from the service in St. Mary's Free Hospital for Children, all treated by the Willems' method.

CASE I. Girl of five years with negative family and past history. Present illness was of two weeks' duration, beginning with pain in the

SUPPURATIVE ARTHRITIS OF KNEE

left knee followed one week later by swelling, redness and stiffness. Cold applications were used, there was fever, but no chills. Examination was negative except for the left knee joint, which was boggy, with free fluid in the joint and edema over the tibia. Tenderness was marked. Passive motion caused great pain. There was no voluntary motion. The knee was held flexed at 45° . The X-ray was negative, throat culture negative, Von Piquet negative, leucocytes 19,600 polymorphonuclears 90 per cent. Temperature on admission was 101° .

Operation was performed by Dr. L. A. Wing, free lateral incisions being used and no drains inserted. Active motion began forty-eight hours later. She was discharged six weeks later, healed, with full range of motion and bearing her weight without pain. Cultures from the knee showed staphylococcus and streptococcus.

CASE II. Girl of six years. Admitted February 1, 1923, discharged March 11, 1923. Present illness began three days before admission, when the child broke off a portion of a sewing needle in the right knee. Severe pain, swelling and disability were noted the following day. On admission the knee was swollen, extremely tender, and contained fluid. Aspirated fluid was thick pus containing the staphylococcus aureus. X-ray showed the fragment of needle in the posterior pouch of the joint. Temperature 102° . Leucocytes 12,800 with 82 per cent polymorphonuclears. Operation was performed at once, free lateral incisions with no drains inserted. The needle was not removed. Active motion was instituted at once. The knee healed promptly with full range of motion and painless weight bearing.

CASE III. Girl ten years of age. Present illness began three days before admission with malaise and pain in both knees and the right ankle with fever. Examination on admission showed a swollen, painful, flexed right knee, with extreme tenderness and spasm. The other joints were tender but soon subsided. Temperature ranged from 105° to 101° . Leucocytes 15,000, 69 per cent, and 17,000 with 80 per cent polymorphonuclears. An osteomyelitis of the right tibia was diagnosed and relieved by operation. Blood culture gave pure staphylococcus aureus on the fifth day. Improvement was rapid, but on the nineteenth day the temperature rose sharply to 104° , the knee became swollen, red, extremely tender, and contained fluid. Operation was performed at once, free lateral incisions evacuating large quantities of thick pus and fibrin masses. Culture was pure staphylococcus aureus. Active motions were begun at once. Progress was slow but persistent. Later a sequestrum from the tibia was removed by Doctor Truesdell. The child is still in the hospital with a small granulating wound over the tibia. She has perfect use of the knee, free range of motion and painless weight bearing.

These three cases illustrate well the modes of infection of the knee-joint. Two probably had general sepsis, one of which developed an osteomyelitis in an adjacent bone and subsequent involvement of the joint by perforation. The other without apparent bone involvement developed an arthritis from the blood stream direct. The third case was due to penetration from without. All three have practically perfect

knees This is especially noteworthy in that one case still has a foreign body in the joint and a second has an unhealed osteomyelitis of the tibia All three do great credit to the Willems' method of treating suppurating knee-joints

DR EDWARD D TRUESDEIL said that the first case presented by Doctor Farr, which had been under his own care, was acutely sick when admitted to the hospital Her temperature had fallen to normal one week after drainage of the knee-joint had been established She was running about the ward four weeks later and had been discharged cured on the fortieth day His own experience had been in line with Doctor Farr's in that septic joints in children seemed to commonly follow direct injury, some local or general infection, an adjacent osteomyelitis or, more rarely, without satisfactory explanation He believed that in infants a suppurating joint was a common source of deep suppuration in the extremity involved and was then difficult to distinguish from a primary osteomyelitis It was also difficult from his experience to forecast the outcome in these cases from the degree of the severity of the symptoms at outset or from the rarity of organism present

DR CLARENCE McWILLIAMS considered these results confirmation of Doctor Willems' theory He could never forget seeing Willems demonstrating this during the War at a military surgical congress in Paris on sixteen soldiers, who with infected knees walked about the room with pus squirting out at each step and in perfect general condition and with perfect joint function, and without any temperature Willems emphasized the fact that active motion compresses the joint by contraction of muscle and hence drains the joint best Passive motions are never to be employed since one would carry the motions too far and do damage Active motions are limited to the point where pain is elicited and this is the point at which to stop Willems carried out active motions every two hours day and night beginning immediately after coming out of the anæsthetic Rarely has any surgical procedure received such full confirmation as this during the War All opposition has been silenced Under the old immobilization treatment these three children would have been doomed to stiff knees instead of having functionally perfect joints Willems' treatment of joint infections is the outstanding one of two brilliant surgical outcomes of the War, and the second is the Carrel-Dakin treatment of infected wounds

DR BURTON J LEE said that in January, 1920, he read a paper before this Society on the question of active mobilization of suppurating joints, and in gathering his material he had sent out a question to the members of the Society "To what extent do you use Willems' treatment of mobilization of septic joints?" There were ten replies from surgeons who disapproved of the method These cases that Doctor Farr had shown of suppurating joints in children are types in whom it is difficult to induce active motion and they are therefore a good demonstration of the results of Willems' treatment In the two cases of his own in which the speaker had been able to carry out the principle the result has been highly satisfactory He felt that the method

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was an excellent one, and that it gave results possible by no other means of treatment

DR EDWIN BLER said that outside of remarkably good functional results obtained by this method of treatment in a fair proportion of cases, on two occasions he had noticed a very interesting phenomenon which might explain the production of loose cartilaginous bodies in joints. Everyone employing this treatment has noticed that the edges of the non-drained incisions tend to agglutinate, and at times the finger must be introduced into the joint and in the knee into the bursa to reestablish adequate drainage. In two cases of this sort he had noticed in the synovial membrane small plaques of cartilage which seemed to have formed as a result of the weeks of chronic irritation. Apparently, therefore, it would seem that by some irritants the synovial membrane becomes changed and by metaplasia cartilaginous islands are produced. X-ray may not detect such changes although at times when extensive and associated with calcification X-ray pictures may be positive. This interesting observation in this type of case Doctor Beer thought very suggestive and perhaps explanatory of the origin of some "joint mice."

DR FRANK S. MATHEWS said that he had been impressed with the frequency with which joint infections and osteomyelitis of staphylococcus origin could be traced to a skin infection, he thought in our present interest in tonsils and teeth, that this source of infection had been largely overlooked. In opening infected joints, he has usually made a small opening so as to be able to distend the capsule with irrigating fluid. After washing it out through this opening, the incision has been increased and second incision made on the opposite side of the joint. He has used the Willem's treatment to a limited extent as he had never been more than half converted to the wisdom of active early mobilization. It seemed to him more reasonable to assume that after a joint is thoroughly drained, that the question of ankylosis will depend not on early motion, but on the degree of destruction of bone and cartilage.

THE LIVER AND ITS RELATION TO CHRONIC ABDOMINAL INFECTION

DR CHARLES GORDON HEYD read a paper with the above title for which see page 55, ANNALS OF SURGERY, January, 1924, vol. LXXIX.

DR WILLY MEYER said that what had principally interested him in the course of the last few years with regard to diseases of the liver and bile system had not been so much the investigation into liver function as that into the fixation of the diagnosis of chronic cholecystitis with or without stones. Every surgeon had often seen macroscopic changes in the liver when operating for chronic gall-bladder disease, such as cicatrices and fibrotic areas in Glisson's capsule, hypertrophy of the liver, bands fixing the convexity of the organ to the diaphragm, etc.

So far, the surgeons in general had not joined hands sufficiently with the pathologists, biochemists and internists doing research work on the liver proper when operating on the bile ducts and the gall-bladder. Doctor

Heyd's procedure of removing a piece of the liver, in such instances, for closer study meant a distinct advance

The definite etiological fixation of the diagnosis of gall-bladder disease with the help of all the scientific means which are at one's disposal at present, he had worked out in conjunction with Doctor Einhorn by analyzing the contents of the duodenum as they were physiologically expelled into this viscus from the bile system. He was convinced that it was necessary to make this examination in the fasting condition of the patient. At the same time, he was ready to recognize the good work done by Lyon, of Philadelphia, but he believed that the so-called Meltzer-Lyon test is of little value with reference to diagnosing disease of the gall-bladder. It is of great value, however, in therapeutics. In view of the facts brought out in Doctor Heyd's paper the test might recommend itself in adipose patients in whom such sudden death, as described by the reader of the paper, might occur without the surgeon being in the least responsible for its occurrence. The test could be used before the operation, in a prophylactic sense, and the operation could then follow. Testing the function of the kidneys before doing a severe renal operation is now habitual.

With regard to the etiology of gall-bladder infection the speaker said he was inclined to side with Graham, of St. Louis, *viz* that the lymphatics carry the infection from the liver to the viscus. Just consider a true case of ptomaine poisoning followed by jaundice. Usually the acute disease, if not too severe, does not last long. There is no acute gastric or duodenal catarrh which would spread upward into the bile system and produce jaundice. It seems to be rather the absorption from the stomach and intestines into the liver which is from there carried to the gall-bladder and bile ducts and is responsible for a subsequent jaundice. Here the modern treatment of whipping the liver into more intensive action, plus emptying the gall-bladder, has done much good.

Doctor Heyd had mentioned three distinct classes of complicating liver affection, which can interfere with normal healing and had also described the best therapy of each of these classes. In order to show the occurrence of still other complications after operations on the bile system, which cannot be laid at the door of the operating surgeon, Doctor Meyer then briefly related the history of a case which has been under his observation within the last year, a lady, forty years of age, the mother of six children, who had had persistent attacks of cholelithiasis. She had shunned surgery out of fear, but at last submitted to cholecystectomy. The gall-bladder, little inflamed, was found to be filled with innumerable small calculi. The operation was not a difficult one and with the usual drainage and closure everything went well. The anæsthesia had been carefully administered by an expert by means of the drop method. The operation was done in the morning and in the evening the patient was in a normal condition. Early the next morning she suddenly went into a profound collapse and a hurry call was sent to Doctor Meyer. He knew that he had ligated the cystic artery separately so there could be no

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secondary hemorrhage, it was too early for acute sepsis. He naturally thought of acute pneumonia, but the anesthesia had been in the hands of a specialist. On reaching the bedside he found the patient with a pronounced acute pulmonary edema accompanied by fever, tremendous increase in pulse rate and scanty and most difficult expectoration of thin mucus with bright red blood. Two hours' work improved the condition, but the patient died twenty-four hours after the operation. Autopsy showed an acute pneumonitis involving the entire right and left lungs except the top of the left upper lobe. Below and around the liver everything was in good order. At the monthly conference of the hospital, after rigid analyzing of the specimens removed, the pathologist pronounced death to be due to a fibrosis of the bundle of His which had produced auricular fibrillation and the acute pneumonitis with pulmonary edema.

This experience showed what may occur after cholecystectomy when pathologic conditions of the liver, as brought out by Doctor Heyd, are not responsible for a fatal outcome, but a chronic lesion exists in any other important organ which post-operatively determines the issue of the case in hand.

DR WALTON MARTIN said he had been looking up recently the autopsy records on patients dying after operation on the biliary passages and it was surprising to see how widespread were the lesions: myocarditis, chronic nephritis, aortitis and endocarditis, as well as degenerative changes in the liver. It would have been difficult in these cases, as in the one Doctor Meyer had just spoken of, to determine the exact cause of clinical conditions preceding death.

DOCTOR HEYD had referred also (a well-recognized point of view) to a frequent association of chronic appendicitis and cholecystitis. The speaker was uncertain often as to the exact meaning of chronic appendicitis. Certainly the completely obliterated appendix could have had little relation to recent infection. It bore, to his mind, about the same relation to an acute process that the scar on a finger did to an antecedent tenosynovitis. As to the very small areas showing low-grade inflammatory signs, he was doubtful if these lesions could furnish toxins to the liver unless the focus was under tension.

Then again, Doctor Heyd had spoken of the theory recently advanced by Evarts Graham regarding the association of hepatitis with cholecystitis, the hepatitis being the usual antecedent condition. Doctor Martin said he felt a certain skepticism regarding the entire acceptance of this point of view. There were of course numerous instances where an acute appendicitis had been followed by an infective portal phlebitis and liver abscess and there were numerous instances where a well-marked suppurative inflammation of the liver had been accompanied by cholecystitis. He recalled the autopsy findings in a case of Doctor Mathews and said he hoped Doctor Mathews would speak of this case. But in autopsy findings in patients dying of acute appendicitis there are usually no signs of suppurative hepatitis and in patients

that recover from cholecystectomy for cholecystitis there is no clinical evidence of a persistent hepatitis. In the follow-up clinic these patients present a most satisfactory group.

DR FRANK S. MATHEWS referred to two cases of early acute inflammatory changes in the wall of the gall-bladder in which the removal of the gall-bladder did not ameliorate the symptoms, both cases went on to fatal termination and were found at autopsy to be cases of biliary abscess of the liver. The colon bacillus was found in the blood of one of these cases, and the inflammatory exudate in the wall of the gall-bladder seemed to be especially located around the vessels. He had thought of these cases as being more likely blood-borne infection than lymphatic, and that the inflammation of the gall-bladder was simply an incident in a miliary infection of the liver.

DR FREDERIC W. BANCROFT said that he had had a case of acute cholecystitis with engorgement of the lymphatics in the muscularis and submucosa, which later proved to be due to pyelephlebitis. This started him reviewing his cases of chronic cholecystitis, and he found in these cases, a round-cell infiltration occurs in the muscularis and submucosa often where the mucosa itself is normal. The histology of these cases coincided with Evarts Graham's theory that chronic cholecystitis is due to a lymphangitis secondary to liver involvement. A history analysis of thirty-four cases of chronic cholecystitis without stone showed that 82 per cent either had had a previous operation for some lower abdominal infection or had a very definite chronically diseased appendix removed at the same time as the cholecystectomy. It will be a real advancement if the liver function can be estimated by phenoltetrachlorophthalin. This test has been estimated by analyses of the stool and by means of the Lyons test, but both of these methods are cumbersome and inaccurate. Recently Rosenthal has proposed a method by blood analysis. If this proves practical it will be a great advantage. The speaker asked Doctor Heyd if he had seen any liver collapse cases following sudden release of pressure in the common duct, where there is jaundice and often white bile. Recent literature by Judd and others has suggested the advisability of intermittent drainage of these cases, clamping the tube for a period of time and then allowing a short period of drainage. In a recent case of his own, this method seemed to be of a distinct clinical advantage.

DOCTOR HEYD said that he agreed entirely with Doctor Martin. The clinical groups that he had drawn attention to were not the cause of the mortality in gall-bladder disease, but they were the exceptional, unexplained causes of some mortalities. When he used the term chronic appendix he was using it in the pathologic sense only and construed a chronic appendix as one that showed either partial or complete obliteration. He thought the appendix was quite as capable of chronic infectivity as was an apical abscess of the tooth and that it was well to remember that when there was a focal infection there might be any one or all of three types of symptoms, local with symptoms confined to the immediate area, secondly, remote symptoms represented in injury to the reno-cardiovascular system, and thirdly, constitutional symptoms in the shape of asthenia, loss of weight and so on. From

LYMPHOEDEMA OF ARM

a pathologic point of view varying degrees of hepatitis had been found in practically all cases of chronic abdominal infection. In the majority of cases these liver changes were without symptoms. It was well to remember that in a very great number of cases of laparotomies there were combined lesions. The general post-mortem rate for disease of the appendix was about 17 per cent. In general abdominal surgery it was about 23 per cent, while in disease of the gall-bladder and stomach we found a pathologic appendix in from 50 to 60 per cent of all the cases submitted to surgery. In so far as white bile was concerned, it only represented a mucosal secretion and was associated with an immediate increase in the operative mortality, but was not a factor in late mortalities after biliary drainage had been established. The reason why there are so few symptoms in rather widespread disease of the liver is due to the fact that nineteen-twentieths of the liver can be put out of commission yet the remaining one-twentieth will carry on the work in a more or less adequate manner because symptoms are not produced.

Stated Meeting Held November 11, 1923

The Vice-President, DR. WALTON MARTIN, in the Chair

LYMPHOEDEMA OF ARM

DR. JOHN DOUGLAS presented a large-framed muscular man forty-five years old, who about five years ago suddenly and with no known cause while leaning forward to lace his shoe, noticed the back of his right hand began to swell. The swelling extended upward throughout the entire upper extremity and in four or five days the whole arm, forearm and hand had attained a diameter of twice the normal. There was no history of any injury. There was no pain or change in color of the extremity. The only previous history of any possible relevance was that of lues and gonorrhoea fifteen years before and the fact that he had had a skin wound which became infected and was slow in healing twelve years previously. A year ago he had a positive Wassermann and received treatment. It is now negative.

On admission to Bellevue Hospital, June 2, 1923, examination showed the right arm to be much swollen and cedematous, although the swollen area did not "pit" like ordinary cedema. The swelling was most marked just above the inner aspect of the elbow where it resembled a large lipoma. It was noticeable that the verrucous skin condition present in old cases of elephantiasis of the leg was not present. The veins over the right shoulder and pectoral region seemed somewhat dilated, but this condition was not present in the arm. The pupils reacted sluggishly to light and the left pupil was somewhat irregular. Knee jerks present but diminished.

Radiographic examination showed enlargement of the left ventricle with widening of the aortic arch. No evidence of pulmonary pathology.

There was nothing abnormal in the laboratory examination. A diagnosis of lymphoedema of the arm of undetermined etiology was made and a Kondoléon operation advised.

The operation was performed on July 12, 1923, but as the patient's right arm was the part affected, and as the condition present was not

sufficient to prevent his ability to carry on his occupation as an electrical lineman, it was deemed wisest not to risk a complete Kondoléon operation, but to attack the most swollen portion above the elbow, on the theory that this could at least do no harm, and that a sufficient anastomosis might be established between the deep and superficial lymphatics to even reduce the swelling below the elbow as well as the area attacked.

An ellipse of skin 17 cm long and 3 cm in width at its widest part, with the underlying subcutaneous fat and fascia somewhat wider, was removed from the inner aspect of the arm just above the elbow down to the anterior brachial muscles in front and the triceps behind. The fat in this area was very oedematous and the connective-tissue separating the lobules thickened and white in appearance. The deep fascia over the muscles was also much changed in appearance, being greatly thickened, white and glistening. It was of interest to observe that the fat and muscle below the deep fascia were not oedematous and did not show this connective-tissue infiltration.

While the etiology of the lesion in the case reported is obscure, the cause of the condition in the case reports of Matas, Sistrunk, Royster, Hill and others, were variously stated as repeated erysipelatous attacks, following a vaccination wound, lymphoedema following removal of the breast and axillary glands for tumor, an injury to the arm two years previously, tuberculosis of the inguinal lymph-nodes, a possibly congenital case (Sistrunk). No etiological factor except possible septic tonsils, an attack of arthritis and furunculosis. In none of the cases reported was the *filaria sanguinis hominis* reported, and attention has been called in the published articles to the necessity as an etiological factor of an infection, usually of the streptococcus type, in addition to the lymphatic obstruction. The rarity of elephantiasis due to filariasis in this country has also been remarked.

Matas states that the histo-pathological elements that are essential to complete the picture of elephantiasis are (1) A mechanical obstruction or blockade of the veins and lymphatics of the affected region, usually an obstructive thrombophlebitis. (2) Hyperplasia of the collagenous connective tissue of the hypoderm. (3) Gradual disappearance of the elastic fibres of the skin. (4) The existence of a coagulable dropsy or hard lymphoedema. (5) A chronic reticular lymphangitis caused by secondary and repeated invasions of pathogenic microorganisms of the streptococcic type.

The speaker had, however, within the past year seen two cases at the Knickerbocker Hospital of lymphoedema of the leg which had not, it is true, reached the stage of true elephantiasis, but in which no evidence of more than the lymphatic obstruction stage was present. One in a young woman from Porto Rico with enlarged inguinal glands on both sides, the *filaria* being present in large numbers in the blood. The other in the leg below the knee in a woman on whom a transverse incision had been made to suture a ruptured ligamentum patella. In neither case was there any evidence of infection by pyogenic bacteria.

In the series of cases reported by Sistrunk in 1918, although cultures were made from the tissues removed, no growth was obtained. Streptococci, however, were grown from the verrucous formations which were

EXCISION OF RETROPERITONEAL ANGIOSARCOMA

present on the arm of the patient who developed elephantiasis, following the infected vaccination. In the case herewith reported staphylococcus albus was reported from culture of the subcutaneous tissue removed. Probably a contamination.

The condition of this patient has greatly improved and he states that the swelling of the forearm, as well as of the arm, has diminished markedly 12 to 14 inches above the elbow and 3 to 4 inches in the forearm. The arm is, however, still swollen and far from normal and the problem now presented is whether further operation this time below the elbow should be performed. The results of the Kondoleon operation have not all been uniformly good and the suggestion has been made that these cases be treated by antistreptococcus serum or vaccines as suggested as a post-operative treatment by Matas and carried out by Sistrunk in his cases.

DR. ALVIN V. MOSCHCOWITZ said that he had done the Kondoleon operation in a few cases, one within the last six weeks. He had done it mostly upon the recommendation of others and his results had been only fair. He could not remember where he got it in the literature, but the operation as he carries it out was somewhat different from the one done by Doctor Douglas. Doctor Moschcowitz incises the tissues and carries the incision down to the fascia, from this fascia he makes a quadrilateral flap which he buries into the depth of the muscle and to the bone and sutures it there. He does not know whether he was right or wrong. In the last case done, an excision of the tissues would not have been feasible and he is sure that he would have had difficulty in suturing the wound together. He will try to present this patient at some future meeting.

DOCTOR DOUGLAS replied that he had not read the original report of the Kondoleon operation, but the method he followed was from Sistrunk's article published in the *Journal of the American Medical Association* in 1918. He stated that this operation was developed by Kondoleon from two previous suggestions by other operators. In 1908, Handley suggested his method of placing long strands of silk in the subcutaneous tissues with the idea of having these strands act as setons in case of lymphœdema. Later in 1911, Lanz made a long incision in the thigh, exposing the bone, which was trephined at several points, and strips of fascia carried down through the muscles and inserted in the openings previously made in the bone. Kondoleon developed these thoughts and improved on them, depending on the idea that by removing the deep fascia, the obstruction caused by the blocking of the superficial lymphatics would be carried off through the deeper lymphatic vessels lying below the fascia. In Doctor Douglas' case it was noticeable that the deep tissues were not œdematous while the superficial were.

EXCISION OF RETROPERITONEAL ANGIOSARCOMA

DR. HAROLD NEUBOR presented a woman, twenty-seven years of age, who was admitted to Mount Sinai Hospital, December 20, 1922. Three years before, patient had a single brisk hemoptysis, but the examination for tuberculosis was negative. One year later an appendectomy was done for persistent abdominal pain, diagnosed as chronic appendi-

citis The patient was then well until about three weeks before admission She then began to have a sensation of fulness in the abdomen after meals, regardless of the amount of nourishment that was taken Loss of weight was also noted, estimated to be fifteen pounds There were no other symptoms

About twenty hours prior to admission there was the sudden onset of violent colicky pains on the right side of the abdomen, vomiting, and great prostration Bowels moved after a cathartic and enemata Pains recurred at frequent intervals and vomiting was twice repeated There was no fever When first seen by the reporter about three hours before she arrived at the hospital, she was in collapse, pale, with a small rapid pulse, but no elevation of temperature Examination of the abdomen disclosed a visibly bulging large mass on the right side, pushing the umbilicus to the left The right rectus was spastic, and there was rebound tenderness The mass was tender, slightly movable, tense, and cystic, occupied all of the midportion of the right half of the abdomen, but was not ballotable into the flank It appeared to be globular, measuring about five inches in each diameter Three hours later, the mass had greatly increased in size, extending well over to the left of the median line, fixed, measuring about eight inches in the transverse diameter The patient had suffered two severe chills, but the temperature was normal The white blood count was 21,200, with 80 per cent polymorphonuclears

Operation was immediately proceeded with, for it was evident that a progressive hemorrhage was going on Upon opening the abdomen through a right rectus muscle-splitting incision, an enormous bluish mass, covered by some greatly dilated veins, at once presented The transverse colon was displaced below it and the mass appeared to be in the transverse mesocolon Its limits were ill-defined, the hand reaching to the left to get around the tumor, coming in contact with the spleen, and to the right, with the right kidney Dilated overlying veins were tied off, the transverse mesocolon was split, and the mass could then be interpreted as retroperitoneal in origin Enucleation of the mass seeming indicated, the layers of overlying connective-tissue were separated until a plane of cleavage was found and a suggestion of capsule was encountered that appeared to hold the blood mass together The median colic vessels were identified, one branch ligated, the main trunks retracted to the left, and blunt dissection continued to the left and around to the posterior aspect of the mass It was then found to be in juxtaposition to, but not derived, from the pancreas After its posterior surface was partly freed, the mass could be partly delivered out of the abdomen for the first time Upon gentle traction it was seen that the right kidney was partly drawn into the wound Dissection was therefore continued on the right lateral aspect of the blood mass the third portion of the duodenum, intimately related to its posterior surface was freed and the mass was then found to narrow down to a readily identified pedicle attached to the upper pole of the kidney The kidney was apparently normal in size and consistency and the pedicle of the mass appeared to cap rather than to involve the upper pole Not being certain of this however he resected the upper pole of the kidney,

THYROID TUBERCULOSIS

using mattress sutures, and removed the kidney pole with the blood clot mass in one piece. The posterior peritoneum was closed about a gauze and rubber dam drain placed into the retroperitoneal space, and the abdominal wall in layers.

The specimen was a spherical mass about 7 inches in each diameter with a thin confining membrane holding the blood clot together. Upon section recent and older blood clot and considerable fluid blood was found. Scattered throughout the blood clot but with some uniformity of distribution towards the periphery, were tumor masses of grayish-yellow color suggesting hypernephroma. The microscopic report was angiosarcoma, the resected portion of the kidney being free from any evidence of invasion by the neoplasm.

The operation was a shocking one and subcutaneous infusions were necessary for the first two days after operation. Thereafter convalescence was uneventful until two weeks after operation. Sudden pain in the right chest and shoulder then appeared; the physical examination and X-ray picture disclosing the existence of a pneumothorax from an unknown cause. This cleared up without treatment. The wound healed by primary union about the drain and the patient was discharged, symptom-free three weeks after operation.

One month later a series of deep X-ray treatments over the abdomen was given. Recently the patient was readmitted to the hospital for examination for the existence of recurrence or metastases. Cystoscopy, abdominal examination, X-ray examinations of the gastro-intestinal tract, chest, long bones were all negative.

It is now eleven months since operation. The patient feels well, has gained 30 pounds and remains free from any evidence of recurrence.

In the absence of any trace of adrenal tissue in the numerous sections taken for microscopic examination this retroperitoneal angiosarcoma cannot be definitely classified as derived from the right adrenal. Its anatomical situation, the freedom from tumor involvement of the upper pole of the kidney to which the growth was loosely attached, the manner in which the neoplasm capped the upper pole of the kidney, and the active hemorrhage, all suggest a tumor of the kidney. This viewpoint is supported by a few cases of adrenal tumor proven by autopsy examination, in which the microscopic examination showed angiosarcoma without any trace of adrenal elements. It is therefore not necessary to find adrenal tissue, or a hypernephroma, or a tumor, composed of nervous tissues in order to establish the diagnosis of an adrenal malignancy.

THYROID TUBERCULOSIS

DR HAROLD NLIHOF presented a woman, thirty-five years old, who was admitted to Mount Sinai Hospital, service of Doctor Elsberg, September 1, 1923. Her previous history is not relevant. One year ago she was treated for a moderately severe typhoid fever, since which time there have been periodical attacks of hemiparesis. Four weeks before admission to the hospital the patient first noted a swelling on the left side of the neck, attention to which was drawn by pain. A similar painful swelling was noticed shortly thereafter on the right side.

of the neck. Inspiratory dyspnoea developed, together with some difficulty in swallowing. No symptoms referable to hyperthyroidism appeared. When the patient was seen about a week before admission to the hospital, a hard irregular mass was found in the lower part of the neck, which had increased perceptibly in size when she was next seen in the hospital.

The general physical examination of this well-nourished patient was negative and the basal metabolism was normal. There was an area of increased dulness to percussion over the upper portion of the manubrium sterni. The mass on the neck was a median, firm, irregular tumor the shape of which did not suggest thyroid. Its transverse diameter was about 10 cm., extending more to the left than to the right of the median line, and the vertical measurement about 7 cm. The mass lay deep in the neck in the suprasternal region, its lower border not being palpable because it extended into the mediastinum. The mass moved with swallowing and appeared to hug the trachea. The ante-operative diagnosis was a malignant neoplasm attached to the trachea, possibly a substernal thyroid.

At operation the thyroid gland was found to be the seat of a firm tumor of rubbery consistency, projecting into the superior mediastinum, especially on the right side. The gland was enlarged two to three times the normal, irregular on its anterior surface, with projecting rounded nodules on its deep surface. The overlying and adjacent musculature was loosely attached to the surface of the tumor. The trachea was closely gripped by the neoplasm, to which it was attached by fibrous tissue in which no plane of cleavage could be found. Similar fibrous tissue fixed the deep surface of the thyroid tumor to the underlying structures. Attached at the thyroid axis on the left side was a firm nodule not connected with the thyroid tumor and interpreted as a metastasis.

The tumor was exposed through a low collar incision. Complete thyroidectomy was rendered difficult by the low and deep situation of the tumor, its consistency rendering impossible, the delivery of the lobes out of the wound, and the necessity for sharp dissection on the posterior surface of the neoplasm. In freeing the right lower pole of the tumor the pleura was exposed, but apparently not injured. The vessels were tied off on both sides beyond the neoplasm. Detachment of the tumor from the trachea could only be accomplished after both lobes had been freed. It was then carried out by sharp dissection laying bare four or five rings of the trachea. The wound was closed in layers, two tubes placed in the dead spaces.

Directly after operation, which was of an hour's duration, the patient's color became dusky, there was progressive respiratory embarrassment and the picture was one of rapidly advancing tracheal obstruction. The midportion of the wound was therefore opened and the trachea exposed. No collapse of the trachea was noted. It was nevertheless opened, with the escape of considerable blood and bloody mucus, the evident cause of the obstruction. A tracheal canula was introduced, surrounded by gauze packings.

After the first day the patient progressed satisfactorily. She was

TUBERCULOSIS OF THYROID GLAND

placed on thyroid extract on the second day after operation. The tracheotomy tube was removed on the third day. Hoarseness of voice was noted and the laryngological examination disclosed paralysis of the right vocal cord. The wound healed rapidly about the tracheal opening, and the patient was discharged three weeks after operation with a superficial granulating wound.

About three weeks ago the patient was seen and found to be suffering from all the manifestations of thyroid deficiency. It was then found that through some oversight she had not been placed on thyroid extract since leaving the hospital. This was given, and she now feels quite well again. The wound is healed and is free from infiltration.

Gross examination of the specimen suggests the diagnosis of a sarcoma in the diffuse invasion of the thyroid gland by what appears to be tumor tissue. Only in the left lobe is any tissue recognizable as thyroid to be found. The peculiar rubbery consistency and the tracheal mould on the posterior surface of the tumor are striking features. The microscopic examination revealed widespread dissemination of miliary tuberculosis with considerable fibrosis.

TUBERCULOSIS OF THYROID GLAND

DR. ALEXIS V. MOSCHICOWITZ presented a patient whose history is as follows: approximately seven or eight weeks ago the patient, who lives in Florida, arrived in New York City, and consulted his physician; he was advised to have his tonsils removed, as they were diseased. This was done by an eminent laryngologist under general anaesthesia. The convalescence after this operation was rather stormy. He ran some temperature for a number of days which did not reach the normal until the eleventh day, even then the remission was of very short duration, as he soon began to have evening temperature up to $104\frac{1}{2}$. He noticed a small lump on the right side of the neck which was exquisitely painful and tender, and interfered with deglutition so that the patient rapidly lost weight. In the absence of all other physical signs Doctor Moschicowitz was loathe to make a diagnosis of an abscess of the thyroid gland, for there was no fluctuation. He operated on the patient with this diagnosis and exposed the right lobe of the thyroid gland and aspirated various portions of it, but, to his chagrin could find no pus. He then incised the thyroid gland and found a densely hard infiltrating mass which involved the entire right lobe of the isthmus. In the best interest of the patient he decided to extirpate all of this infiltrated tissue and left only a small portion attached to the posterior capsule. The entire wound was left wide open. Within forty-eight hours the temperature came down to normal and the patient made a very prompt recovery. He has been gaining in weight approximately at the rate of a pound a day.

The tissue examined by Doctor Mandlebaum showed a diffuse miliary tuberculosis of the thyroid gland, with a superadded acute infection of some other nature. The bacteriological examination was negative. Finally it is but proper to add that this specimen was seen by another pathologist who did not know the history of the case and who pronounced it a lympho-granuloma of the thyroid gland.

DR LEO EDELMAN (by invitation) said that sections taken from Doctor Neuhoﬀ's specimen clearly show the typical miliary tubercle formation consisting of masses of endothelial cells with giant cells in the centre. Doctor Neuhoﬀ's case undoubtedly falls within the group reported as caseous tuberculosis of the thyroid. This type forms a tumor, rather firm in consistency, growing rapidly in size, painful to pressure, with diffuse limits, and has a tendency to infiltrate neighboring tissues. The diagnosis is rarely made before operation. Localized areas of tuberculosis have been detected in a simple goitre without clinical or pathological symptoms. It is a known fact that the thyroid reacts to infectious processes in and about the throat. Doctor Moschcowitz's case showed a picture of the combined effects of tuberculosis and a toxic thyroiditis. The microscopic sections of a thyroid recently removed from a patient who presented the typical symptoms of Basedow's disease, gave confirmation of the diagnosis, but in addition there were found numerous miliary tubercles. The patient had no clinical manifestation of pulmonary tuberculosis. Some authors seemed to think that there was a definite relation between goitre, Basedow's disease and tuberculosis. Experimentally, however, it is most difficult to produce tuberculosis in a thyroid.

DOCTOR MOSHCOWITZ said that he believed that in the case he presented the diagnosis of an acute thyroiditis of an infective nature was justified in every respect. As to the pathogenesis and course of the infective agent, he was under the impression that the only logical way to explain it was, that the entire illness followed tuberculosis of the lingual tonsil which was also extirpated at the original operation and that the tubercle bacillus entered the thyroid gland through the isthmus which as is well known is embryologically connected with the lingual tonsil.

ACUTE PERFORATION OF GALL-BLADDER

DR JOHN A. MCCRELRY presented a woman, aged sixty, who was admitted to the First Surgical Division of Bellevue Hospital, March, 1922. Six hours before admission she had been awakened by severe knife-like pain localized in epigastrium and left upper quadrant of abdomen. Pain had persisted with original intensity until admission, but it gradually shifted to the right upper quadrant with radiation to the back, but not to the shoulder or lower abdomen. Following onset of pain she had vomited several times, vomitus consisting of greenish-yellow fluid with no blood. Bowels had moved once following onset, the stool being normal in appearance. There were no urinary symptoms, no chills or fever. Patient said she had never had any similar previous attacks.

Past history revealed somewhat indefinite symptoms of indigestion, covering a period of 15 to 20 years, the onset of these symptoms following menopause. Patient never had typhoid fever and had never been pregnant.

On admission patient's temperature was 98.2, pulse 56, respiration 18. White blood cells 14,100, with 86 per cent polymorphonuclears. While evidently suffering severe pain patient did not look acutely ill. Her abdomen

GIANT-CELL TUMOR OF CLAVICLE

was rounded did not move with respiration, and showed generalized rigidity, most marked in the right upper quadrant. Liver dulness was present. There was no evidence of free fluid.

At operation the gall-bladder was found thin-walled, the walls blue in color. On left side of the gall-bladder, about mid-way between the apex and base, at the point where the peritoneum was reflected to the lower surface of the liver, there was a perforation about 3 mm. in diameter, irregular in contour. The surrounding bladder wall was not thickened. There was a moderate amount of fibrin between the gall-bladder and the lower surface of the liver in front of the duodenum. The upper part of the peritoneal cavity contained 8 or 10 ounces of thick bile, which was partly shut off from the lower abdomen by adhesions between the omentum and the abdominal wall. The pancreas, stomach and duodenum were apparently normal. No enlarged lymph-nodes were felt along the common duct.

A cholecystectomy was performed rather than a cholecystostomy, as it was felt that a closure of the perforation would be difficult and drainage unsatisfactory.

Her post-operative course was complicated by frank pneumonia and by disruption of the wound, as a result of which patient at present has a ventral hernia adequately controlled by a truss, which at the present time gives her no symptoms.

The pathological report by Doctor McWhorter was that the gall-bladder was normal, except in the immediate region of the perforation, where the blood-vessels were thrombosed and the gall-bladder wall cedematous and infiltrated with leucocytes. Doctor McWhorter felt that the perforation was embolic in origin. Culture of bile and peritoneal fluid was negative.

While perforation of the gall-bladder is not rare, it practically always occurs in a gall-bladder which has been previously the seat of chronic inflammatory changes subsequent to cholelithiasis. In this case, however, the gall-bladder was previously normal and the perforation was an acute accident, apparently the result of an acute vascular lesion, the cause of which was not determined.

GIANT-CELL TUMOR OF CLAVICLE

DR FRANK S. MATHEWS reported the history of a woman, now fifty-three years of age, who was seen by him first ten years ago with a cyst of the left breast with clear contents. The breast only was removed. After operation the condition was reported adenoma, possibly adenocarcinoma. Nothing more was done. Five years later a small nodule occurred in the skin one inch from the original incision, which was excised and pronounced carcinoma, similar in type to the original condition in the breast. In the interval, patient has had lobar pneumonia and operations for acute appendicitis, prolapse of the uterus, and gall-stones. Ten months ago, patient fell, sustaining contusions of the left elbow and shoulder, following which she complained of pain of considerable severity located about the shoulder. An X-ray taken six months ago revealed nothing. Some time afterward, as a result of a slight

injury, the clavicle fractured Doctor Mathews did not see her thereafter until three months ago, when another X-ray showed evidence of central tumor of the clavicle, with fracture at the junction of the inner and middle third of the clavicle With the history of the breast tumor in mind, it was feared that this might be a metastases Operation removed the inner half of the clavicle with surrounding soft parts The tumor appeared solid and had expanded the bone, measuring about one and one-quarter inches in its longest diameter Microscopic examination showed it to be a typical giant-cell tumor of the bone, and in this case as in many others of giant-cell tumor, there is a definite history of trauma, although in this case it was indirect, direct application of violence being to the elbow and tip of the shoulder

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DR WILLIAM B COLEY read a paper with the above title, for which see page 321, *ANNALS OF SURGERY*, March, 1924, vol lxxix

DR FRANK S MATHEWS said that his first giant-cell tumor was treated conservatively in 1903, and remained well for as long as he was able to follow the case Another case of giant-cell tumor of the tibia operated on twelve years ago has remained well until the present time These cases were reported in a paper read before this Society entitled "Myeloma of Long Bones," a name which he adopted following Adam to call attention to their comparatively benign character This was unfortunate, as pathologists are limiting the term "myeloma" to describe an entirely different class of tumors There can be no doubt that there is a group of tumors occurring in the medulla of the long bones characterized by an abundance of giant cells of a particular variety and which is benign in its course The point is debatable as to whether there is a second and smaller group of central bone tumors having giant cells, resembling the first group, and which is clinically malignant, and if there is such a class, it is a point of greatest interest to know whether pathologists of the present and future will be able to distinguish the benign from the malignant Some of Doctor Coley's cases would lead one to think that even the best pathologists had differed regarding the malignancy of these tumors Doctor Coley's own experience has been that nine out of fifty of these cases have shown metastases Pathologists seem to think that the general surgeon has little information regarding the pathology of these tumors One pathologist has considered it a demonstration of their ignorance because several surgeons in a particular case recommended amputation It is not clear, however, that the recommendation was the result of ignorance of the course of these tumors but may have been based on an opinion that the member would be practically useless after local destruction of the tumor

DR H H M LYLE said that he had observed, in his own cases, a preponderance of women over men, out of eight cases, seven were women Out of the five cases shown by Doctor Coley this evening there was only one man He wanted to know the incidence of male and female Regarding the closure of the large bony cavities after curetting Doctor Lyle has been

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able to save a great deal of time by filling these cavities with attached muscle flaps, this allows of immediate closure. He has also tried free fat graft, but his results with these have been poor.

DR HOWARD LILIENTHAL said that it appeared to him impossible to make an accurate diagnosis of malignancy without operation unless there were metastases. It had been clearly shown that a malignant tumor might remain localized for a number of years. The history of the case, combined with roentgenograms might lead one into error. In one case from the speaker's experience, diagnosis had been made of giant-cell sarcoma of the lower end of the tibia principally on the evidence of the roentgenogram. The thinness of the bone, however, made it necessary to operate and believing the case to be non-malignant, Doctor Lilienthal had removed it with a large, sharp curette down to what looked like healthy bone. Doctor Mandlebaum reported that the specimen was one of extremely malignant osteosarcoma. It appeared to the speaker that with Doctor Codman's figures in mind, amputation would probably be worse than useless. Radium could be of but local benefit, these cases almost invariably metastasizing. On account of the speaker's results with Coley's toxins he advised their employment. They were used and about two years after operation the patient was apparently well and walking. Doctor Lilienthal said that there was less danger in making an operative diagnosis in these cases than to treat them symptomatically, provided the tumor was solitary. He thought that it would be well not to amputate with the idea of saving life, but perhaps for some other reason, such as the size of the tumor or unbearable pain. He also again emphasized the importance of toxin treatment.

DR GEORGE WOOLSLY said that he had seen more giant-cell tumors in the lower end of the femur than in any other bone. The first case, involving the inner condyle, he operated on in 1910 with curettage and carbolic acid and in eight months it recurred and then involved the entire lower end of the femur. He curetted again and shortly afterward, as there was great vascularity and much oozing and the patient wanted to be rid of it, he amputated and the patient had had no recurrence. The first pathological report was giant-cell sarcoma with many spindle cells. This case was not like others he had seen, the lining of the cavity was not smooth and composed of a thin layer of bone, but rough cancellous tissue. It also pulsated. When the specimen was examined it was very vascular, with spindle cells and giant cells and was diagnosed bone aneurysm. Two other cases had been operated on by curettage and cauterization by carbolic acid and then had been treated by X-rays. One has remained well for eight years. The other, quite an extensive case, involving the entire inner condyle, was operated about 6 months ago. The cavity is now filled up and the patient has perfect use of the leg.

DOCTOR COLEY, in closing the discussion, said that he believed Doctor Mathews and himself were practically in accord in regard to the prognosis of giant-cell sarcoma. He agreed with Doctor Mathews that the majority of giant-cell sarcomata were benign or only locally malignant.

but his series of cases, together with cases reported by other men showed that there was a certain group, small, but not too small to be ignored which could not be differentiated from the benign type either by clinical, X-ray, and not always by microscopical examination, in which the disease continued to progress in spite of conservative treatment, ending in death from metastases. Ten of his own series of fifty cases ended in metastases. In view of the importance of this group of malignant giant-cell sarcomata, he believed that every method of making a diagnosis should be employed, and therefore the most important and exploratory operation should not be given up. In dealing with a true benign giant-cell tumor, exploratory operation and curettage is an important part of the treatment. Doctor Coley, in replying to the question raised by Doctor Lyle as to the sex and age of the patients, said that, while it was true that only one of the five patients which he showed this evening was a male, and the other four females, this did not represent a true portion and one should not draw a conclusion from too small a number of cases. His entire series of fifty cases showed 23 males and 27 females. As to the age, the disease occurred from five to ten years in 4 cases, from ten to fifteen years in 5 cases, from fifteen to twenty years in 8 cases, from twenty to thirty years in 17 cases, from thirty to forty years in 6 cases, from forty to fifty years in 5 cases, from fifty to sixty years in 4 cases, and over sixty years in 1 case. While Doctor Bloodgood's later series of 18 cases of giant-cell sarcoma showed fifty per cent to have occurred in the radius in Doctor Coley's series of 50 cases, the disease occurred in the radius in only 7 cases, and in the femur in 22 cases. Doctor Coley remarked that the great bulk of giant-cell sarcomata occur in the lower end of the femur and in the upper end of the tibia. In Doctor Coley's opinion, the case of Doctor Lilienthal, illustrated very well, the great difficulty of making a diagnosis of benign or malignant tumor from the X-ray and clinical evidence alone, as in this case, the X-ray and clinical evidence pointed almost conclusively to a giant-cell sarcoma, and yet, exploratory operation revealed a malignant osteogenic sarcoma. The patient was treated with the mixed toxins, almost immediately after the exploratory operation, which treatment was kept up for a prolonged period. Doctor Coley stated that the patient was in good health at the present time, with a perfectly useful limb one and a half years, he showed a picture of the case.

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Remittances for Subscriptions and Advertising and all business communications should be addressed to the

ANNALS of SURGERY

227-231 S. 6th Street

Philadelphia, Penna.

ANNALS of SURGERY

VOL LXXIX

MARCH, 1924

No 3

PROGNOSIS IN GIANT-CELL SARCOMA OF THE LONG BONES

BASED UPON THE END-RESULTS IN A SERIES OF 50 CASES

By WILLIAM B. COLLY, M.D.
OF NEW YORK, N. Y.

THE theory that giant-cell sarcoma is always a benign lesion and never metastasizes dates back to the middle of the nineteenth century. In 1854 Sir James Paget in his lecture on Surgical Pathology (Lecture 28 part 1 p 446) gives Lebert (Physiologie Pathologie D. Balhère 1845, vol II p 120) full credit for being the first one to describe giant-cell tumors. Paget himself nine years later gave a most accurate description of these tumors which Bloodgood well says has never been improved upon by any subsequent writer. A portion of Paget's description is well worth quoting:

"The cut surface appears smooth uniform compact shiny, succulent with a yellowish not a creamy fluid. The cut surface shows blotches of dark or livid crimson or brownish or bright-blood color or pale pink or all of these tints mingled on the grayish-white or greenish basis color. The tumor may be all pale or have a few points of blotching on the cut surface or may be nearly all suffused like the cut surface of the heart or spleen.

After a study of Lebert's cases as well as a few of his own, Paget very modestly concludes that his observations are too few and too various to warrant many general conclusions. Those which he tentatively expressed however were:

"The tumor is single, occurs most frequently in youth, rarely in adult age is slow in growth, and without pain, and generally comes on without any known cause such as injury, has no tendency to ulcerate * * *. They may (but I suppose very rarely) cease to grow. They are not apt to recur after complete removal nor have they in general any features of malignant disease."

And then at the end, Paget very wisely adds that while these and many other cases may be enough to prove that the myeloid tumors are generally of an innocent nature, "still, I suppose, cases may be found in which, with the same apparent structure, a malignant course is run." Further observations have shown some of Paget's conclusions to be incorrect. We now know that injury is a very important factor as an exciting cause, not less than fifty-six per cent of my series of cases give a distinct history of antecedent local injury. We also come to recognize pain as one of the earliest and most constant symptoms.

Nélaton in 1860, published the most lengthy monograph on the subject.

* Read before the Southern Surgical Association, December, 1923.

that has ever been written, further strongly advocating the view that giant-cell tumors are only locally malignant, and furnishing much new data in support of this view. Bloodgood for many years has upheld this doctrine, and it is not too much to say that at present the majority of pathologists here and in Europe have accepted it. This view has been expressed so often and



FIG 1—(Case No 1 in text) Sarcoma of humerus, microscopical diagnosis, giant-cell sarcoma. Amputation, death 15 months later from metastases in lungs

so emphatically that many surgeons have accepted it without a sufficiently careful or critical examination of the data upon which it is founded.

When I became interested in the study of long-bone sarcoma more than twenty-five years ago, I had no definite opinions as to whether the central giant-cell sarcomas were benign or malignant. I did, however, keep a careful record of the cases and followed up the end-results in the great majority. An analysis of these end-results should be of interest to the surgeon, and should furnish additional data upon which to base an opinion in regard to the prognosis of giant-cell sarcoma. Furthermore, this study

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should give some help in determining the choice of method in the treatment of these tumors

Let us begin by attempting to describe what is meant by giant-cell sarcoma. Various names have been given it, beginning with *tumeur à*

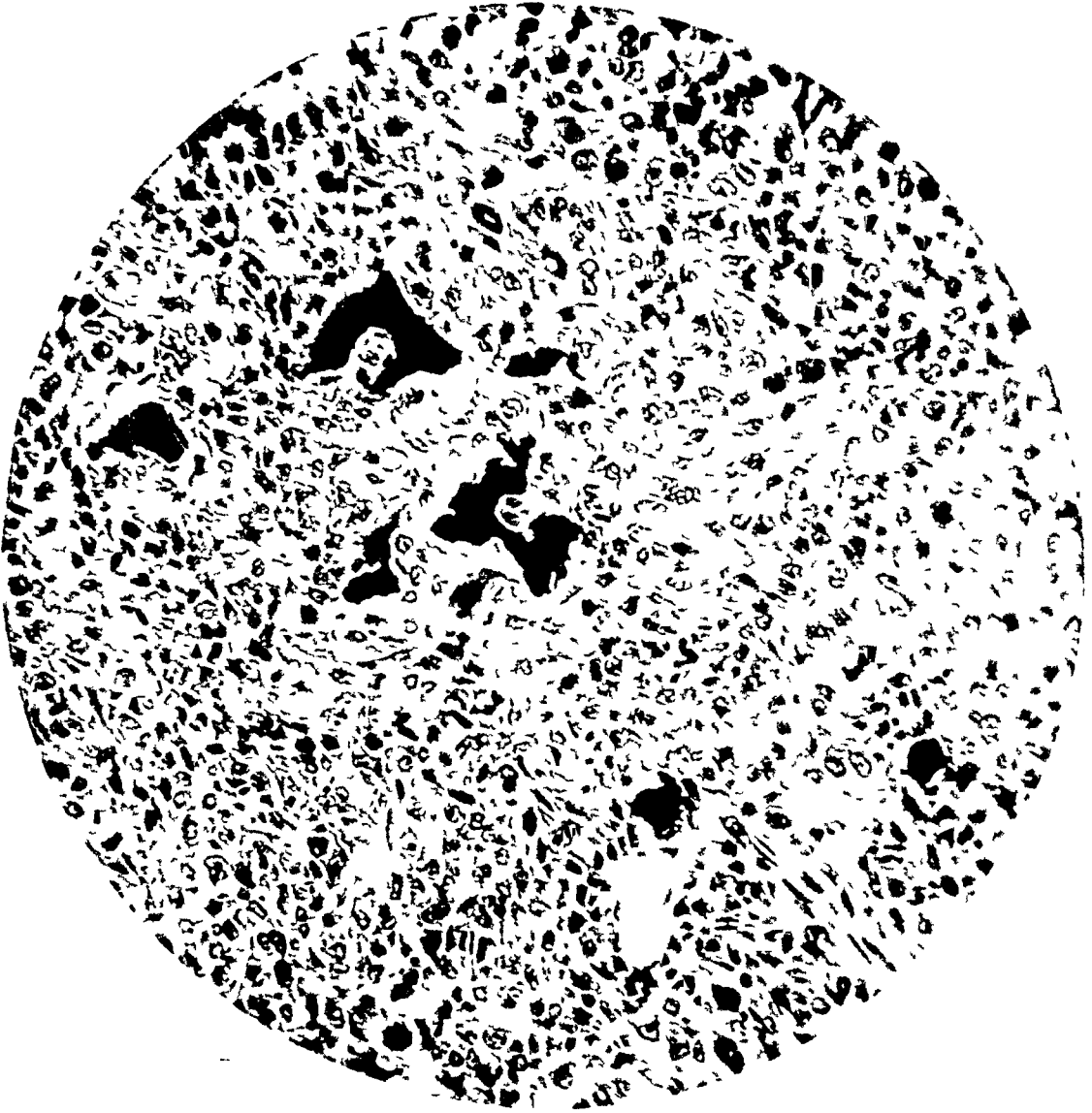


FIG 2 —(Case No 2 in text)

myeloplaxes (by Nelaton), myeloid sarcoma a name almost universally used from 1870 to 1910, and still used in British literature, giant-cell sarcoma, benign giant-cell sarcoma of the epulis type, giant-cell tumor (Bloodgood), osteitis fibrosa cystica (von Recklinghausen), hemorrhagic osteomyelitis (Barrie). The term most generally used to-day is giant-cell tumor or giant-cell sarcoma of the epulis type.

Clinical Description of the So-called Benign Giant-cell Sarcoma My own series shows that the disease had existed less than six months in 50 per cent of the cases and more than one year in only six cases. This tumor is usually said to be of long duration and slow growth, but this is by no means

always true, it is situated near the extremity of one of the long bones, the upper end of the tibia, lower end of the radius, and lower end of the femur is the most frequent site, although it may occur in any of the bones. Of other bones, the lower jaw is the most frequent site. There is usually a history of antecedent injury, some writers say it is practically always the result of trauma. My series shows trauma in 56 per cent of the cases. In

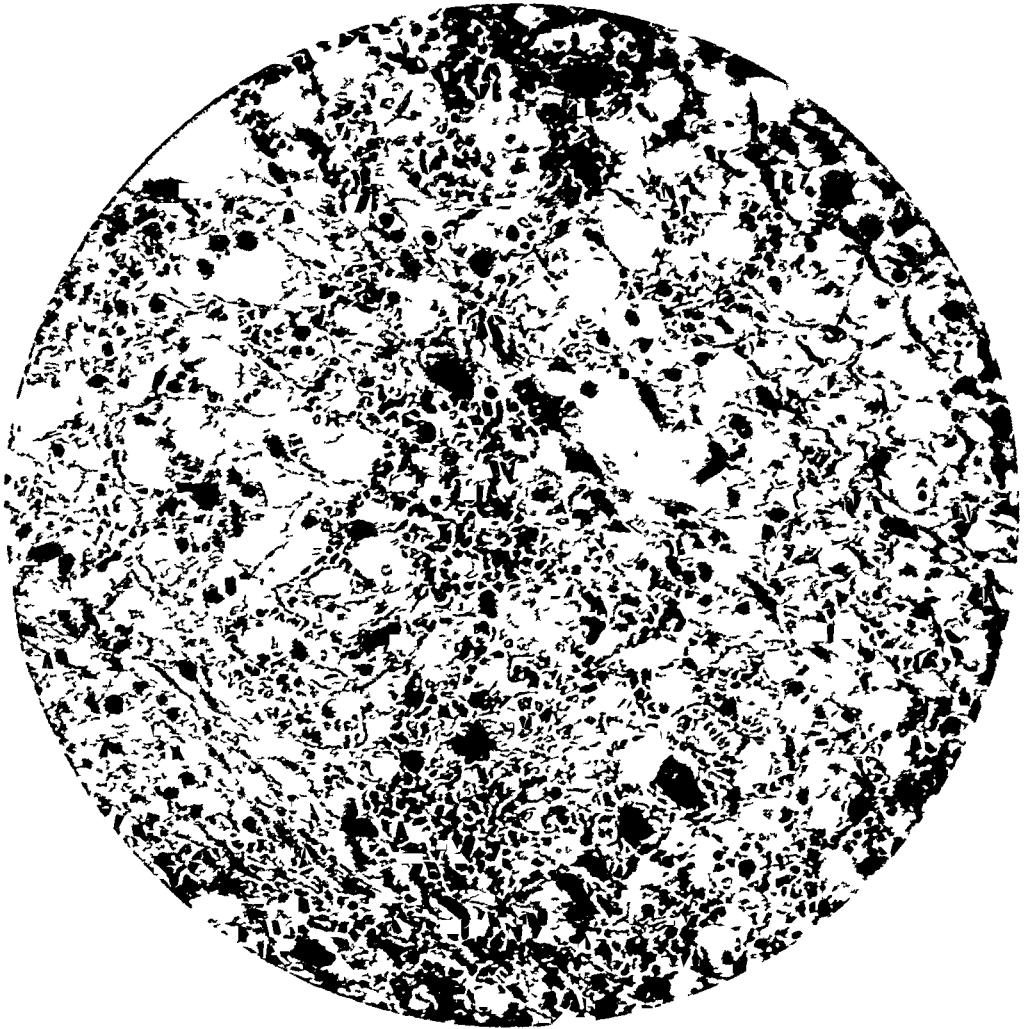


FIG 3 —(Case No. 2 in text)

a few cases (5) it has followed a recent fracture. It gradually expands the bone, destroying the bone slowly by absorption, but rarely breaking through the periosteum, and still more rarely invading the neighboring joint. If the bony shell overlying the tumor is very thin, a peculiar "egg-shell" like crackling may be elicited on pressure, this, however, is so seldom seen that it is of little practical value in making a diagnosis. In some cases the superficial veins are enlarged. Pain is one of the earliest symptoms and is usually more severe than in the periosteal type. Limitation of function will depend on the size and location of the tumor. X-ray examination will show a fairly

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characteristic appearance. The centre of the bone will show a more or less complete destruction of bone, leaving a shell of bone of varying thickness. The periosteal line is rarely invaded, except in far advanced cases. In some cases but not in the majority, the area occupied by the tumor has a multi-

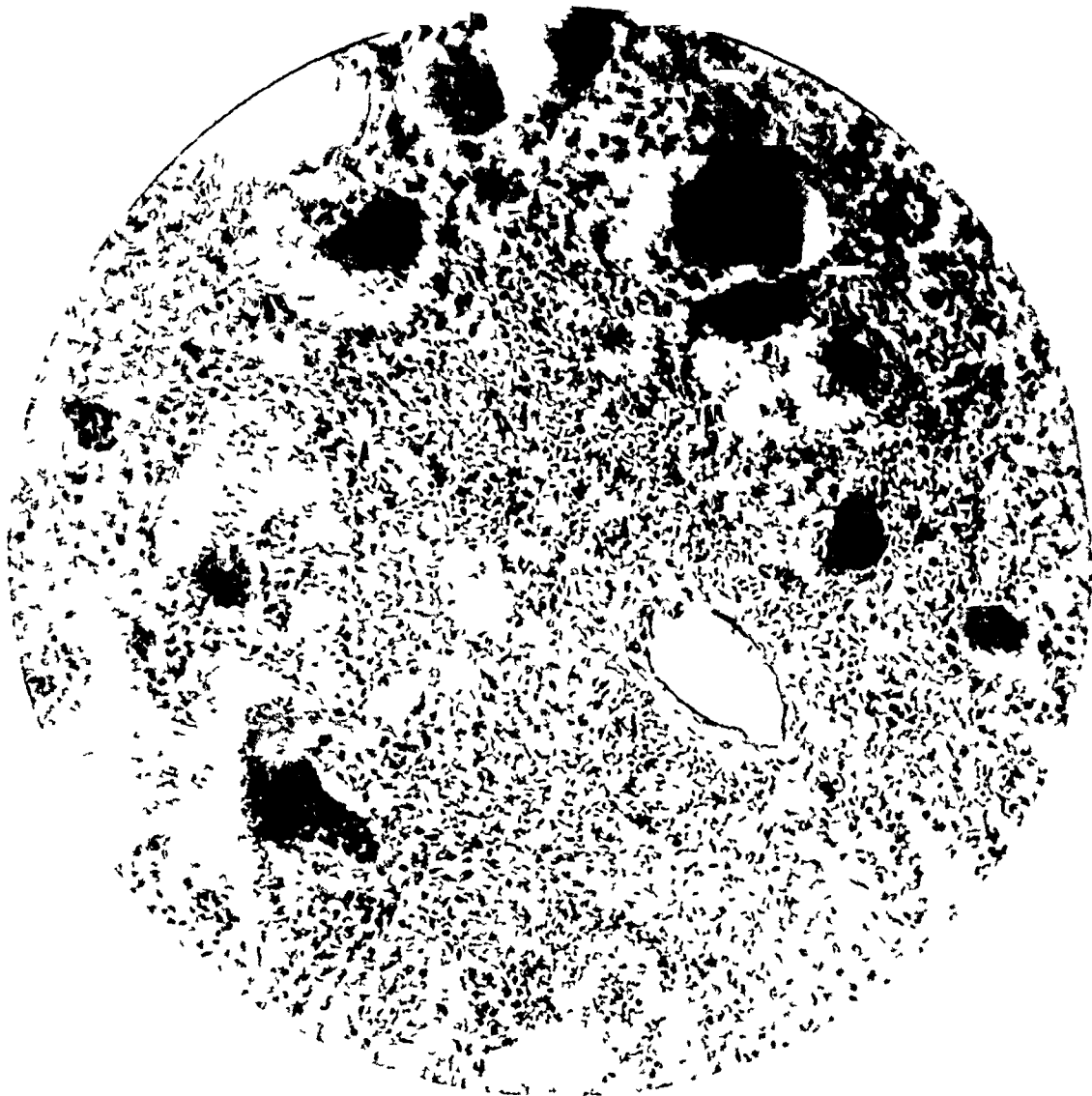


FIG. 4—(Case No. 2 in text.)

cystic appearance. The X-ray picture cannot always be differentiated from a malignant central sarcoma.

Gross Appearance of the Tumor. The tumor tissue is usually made up of solid portions and numerous small cysts filled with yellow or reddish serum. The solid portions are friable in consistence, and vary in color from a yellow to a dark red. They often look like a portion of liver. These tumors are often of great vascularity and there may be difficulty in controlling the hemorrhage after curetting.

One of the most recent contributions to the subject has been made by Martland (Proceedings of the New York Pathological Society, 1921, vol. XXI, Nos. 1-5, p. 102), who for many years has been very much interested in bone tumors, especially of the giant-cell type. He states that, "Benign

giant-cell tumor, medullary giant-cell sarcoma, giant-cell sarcoma of the epulis type, medullary giant-cell tumor, chronic non-suppurative hemorrhagic osteomyelitis (Barrie), etc., has been recognized for many years by a few surgeons and pathologists as essentially a benign lesion of bone. This fact, however, is unfortunately not appreciated by most surgeons, in spite of all the literature written on the subject."

Martland gives a very good description of these tumors. He states that, "In gross appearance the tumor is usually confined within the periosteum, definitely circumscribed, not infiltrating, and is easily removed from its bony shell. It is distinctly vascular, simulates young granulation tissue, is friable, soft, oozes and resembles red-currant jelly or fresh-cut liver." This coincides very closely with the description given by Nelaton in 1860.

Martland refers to two cases that had come under his observation, one for a period of ten years, a benign giant-cell tumor of the lower end of the tibia, which lesion had been curetted several times.

In conclusion, Martland states, "From my observations in these two cases, I am of the opinion that so-called benign giant-cell tumor is entirely an inflammatory process in the nature of exuberant granulation tissue, located mainly in the myeloid part of the bone, formed as an attempt to repair previous bone destruction, due to trauma in the single lesions and in the multiple ones to some unknown cause. I believe the disease is one phase, or rather an exaggerated phase, of osteitis fibrosa cystica."

According to Martland, benign giant-cell sarcomas are always surrounded by a layer of bone and do not break through this bony shell. My own series contains several cases classed as giant-cell sarcoma or giant- and spindle-cell sarcoma, in which the bony capsule was entirely broken through and the neighboring joint invaded, with beginning infiltration of the soft parts. In these cases, the disease was of rapid growth, and in three cases had completely destroyed the knee-joint.

One of the best descriptions of the histological structure of these tumors may be found in the article on *Bone Sarcoma* by Ewing (Archives of Surgery, 1922, vol. iv, p. 496). He states

"The structure shows an abundance of giant cells with many small separate nuclei. They appear in masses or they surround capillaries or blood spaces. They are derived from the vascular endothelium but participate in the tumor process, sometimes extensively. The stroma is composed of many capillaries supported by a moderate number of spindle fibroblasts, with nuclei showing normal or slightly increased chromatin. Tumors of this type are always strictly benign, in the oncologic sense, although they may lead to serious clinical disturbances. They may be cured by curettage, by Röntgen-ray and radium, and some of them disappear spontaneously. They may become transformed into simple cysts. They are prone to become infected from curettage or exploratory incision, and a progressive cellulitis and osteomyelitis may develop. The wide cavities left after curettage may offer some surgical problems."

Ewing further states "I have never known these tumors to produce metastases, and I have been unable to find authentic records of such complication, but it seems quite possible that by curettage groups of viable cells could be dislodged from the tumor and pass into the blood-vessels."

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As to the origin of the giant cells, pathologists differ widely. Adams believes them to be myeloplaxes, the view originally held by Nélaton, and that they differ from the foreign body giant cell in the even distribution of the nucleus throughout the cell body, and in the absence of the central degeneration of the cells, and further that they differ from the true tumor giant cells in that their nuclei are well formed. Mallory and Barrie believe them to be foreign body giant cells. Stewart of Leeds strongly opposes this view.

Before taking up the main subject of this paper, prognosis, we must be sure that we are dealing with the same condition, and that brings up the question: is it always possible to make the diagnosis? Bloodgood believes that he can always make the diagnosis by the microscopic examination, and Ewing is of the opinion that the diagnosis can nearly always be made by the clinical history, physical signs, and X-ray picture, without the exploratory operation, which he strongly condemns. Yet Ewing admits a group of "border-line cases of giant-cell tumors" which he describes as "some bone tumors mainly central in location and found to have involved much of the neighboring bone shaft which is eroded or perforated while the tumor tissue easily penetrates the soft tissue and fails to throw out a uniform limiting shell of bone. The structure consists of numerous large spindle cells. The cells may appear polyhedral, giant cells are scanty or absent in many areas, but appear in groups often in the clefts or sinuses of tumor tissue. They are not so large as the giant cells of the ordinary giant-cell tumor and the nuclei while multiple are larger and more hyperchromatic. The diagnostic difficulties are increased when only curetted fragments of the tumor are available. Such tumors are a difficult problem for the pathologist and the surgeon. My colleagues and I have adopted the policy of designating these tumors as border-line tumors of the giant-cell type, and giving a guarded prognosis. They are prone to recur after curettage, but I have never known them to produce metastases even after repeated insults." Ewing believes this group probably belongs to the benign giant-cell tumors. Platou, of Christiania, who made a histological study of nine cases of giant-cell sarcoma, while holding that the majority of these tumors are benign, admits the difficulty of making a positive diagnosis, and he concludes with this statement: "It is deplorable that a microscopic examination sometimes permits only of a probable diagnosis. There has not yet been discovered any test whereby the diagnosis may become absolutely certain either way when the cases are doubtful."

Nélaton, in his splendid monograph on *Tumeurs benignes des os ou tumeurs à myeloplaxes* (Paris, 1860), made the first serious attempt to differentiate the different types of bone tumors, with special reference to their malignancy. This report covers 364 pages, and is based on a study of 46 cases of giant-cell sarcoma, chiefly collected from the medical literature and hospital reports in France and in England, and includes only six cases representing personal observations. The monograph contains an excellent

series of drawings, showing both the macroscopical and microscopical appearances of the tumors in question

Nelaton believed that the new kind of tumor which he describes was practically benign in character, and while often highly malignant locally, it never caused death by metastases, and was sufficiently different in gross and microscopical appearances to enable one to differentiate it from the more malignant types of bone sarcoma



FIG 5 —(Case No 3 in text) Benign giant-cell sarcoma of tibia, recurrence after repeated curettage and repeated radium treatment amputation recurrence, extension of disease in pelvis death

and 2 of the dorsum of the foot Tumors of the jaw of the giant-cell epulis type, for many years have been recognized as usually benign There were only 11 cases of tumors of the long bones (4 of the femur, 6 of the tibia 1 of the humerus, and 2 of the radius) Inasmuch as these were operated upon before the time of Lister's discoveries it is not a matter of surprise that 4 or twenty-five per cent of these cases died of infection following operation The most striking point brought out is, that of the 14 cases treated by amputation only 2 were well for 3 years (1 of the femur and 1 of the radius) 5 were traced for less than one year, and 4 were not traced at all In other words of the entire series treated by most radical surgical operation (amputation) only 2 cases were known to be well over three years Hence we see at a glance how absolutely impossible it is to draw any

Nelaton was wrong in his belief that these tumors never metastasize, as was proven nineteen years later by Gross in his classical paper on *Sarcoma of the Long Bones*, in which he reported five cases of myeloid or giant-cell sarcoma associated with metastases of the lungs Furthermore, at a symposium on Long-bone Sarcoma before the Royal Society of Medicine, in 1912, two other cases associated with lung metastases were reported

While Nelaton is an authority who is constantly being quoted in proof of the benign character of giant-cell sarcoma of the long bones, I doubt if many of the writers who quote him have read his book An analysis of 46 cases forms the basis This includes 15 cases of tumor of the upper jaw 14 of the lower jaw

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conclusions whatever as to the main question at issue, namely, the benign or malignant character of these 14 tumors. Had they all been highly malignant central sarcomas, we could reasonably expect 2 to have been cured by amputation. Bloodgood has stated that 10 per cent of malignant central sarcomata are cured by amputation.

As we have stated, only 6 of the 46 cases were personal observations, the remainder having been collected from the medical literature. Many of these case-reports were lacking in essential data, yet the most serious difficulty found in Nélaton's statistics as far as their value in estimating the malignancy of tumors is the fact that the end-results in these cases are almost entirely lacking. In reviewing his report of 29 jaw tumors of the epulis type we find only 2 of the 15 cases of the upper jaw, well over three years, and 4 of the 14 cases of the lower jaw well over three years, 3 died of infection, 6 were traced for less than one year, and the remainder were not traced at all.

In addition, Nélaton reports in full detail, two other cases one involving the sternum, clavicle, scapula, ribs, and later the spine, in which the disease progressed rapidly causing death within a few months, he regards these lesions as multiple primary tumors rather than metastases, but from the clinical history and our later knowledge, it is very probable that he was dealing with either a metastasizing giant-cell sarcoma or a multiple myeloma, a highly malignant type of tumor. The other case involved the sacrum and lower dorsal spine, causing death in a comparatively short time. It is hard to see how these cases could be fairly included in a group of benign tumors of the bone when the disease killed the patient from multiple tumors, although, without causing metastases in the lung.

Whatever may be the final decision as to the benign or malignant nature of giant-cell sarcoma of the long bones, it is quite evident that the question was not settled by Nélaton and that it must rest upon a careful follow-up of the end-results of a large number of more recent cases.

If we take another series of 93 consecutive cases of long-bone sarcoma



FIG. 6—(Case No. 3 in text)

observed by Van Brun s Clinic from 1860 to 1903, reported by O Kocher (Beit z Klin Chir, 1906, Bd 50 Hft 1, p 118) we find 28 cases ruled out on account of defective histories, of the remainder, 32 were classified as periosteal, and 33 as myelogenous, the old term for giant-cell sarcoma. Unless the condition is comparatively rare, there must have been some so-called benign giant-cell sarcomas at this large clinic during a period of forty-three years, and if there were, they must be found in this group of 33 myeloid sarcomas. A study of the end-results of this group is, therefore, of great interest, 24 cases were treated by amputation, 7 by exarticulation, 4 died of the operation, leaving 20 cases, of these

15 were traced,

13 died of metastases,

2 living and well (15 and 20 years, respectively)

Of the 4 cases treated by resection

1 died of operation

1 died of metastases,

2 living and well (17 and 27 years, respectively)

Thus of the 33 cases of myeloid sarcoma, only 4 are known to have been alive more than three years. One must conclude that there could have been few benign giant-cell tumors in this group, for if there had been, they must certainly have been cured by such a radical operation as amputation.

The profession is deeply indebted to Bloodgood,* for being one of the first to attempt a scientific study of the important question of the relative malignancy of giant-cell tumors, and by his painstaking effort, he has established the fact that the great majority of these tumors are only locally malignant. His work has had a marked and increasing influence on the surgical treatment of giant-cell tumors. While in Bloodgood's earlier series of 18 cases (ANNALS OF SURGERY, 1910), only one out of eight cases of giant-cell sarcoma of the radius was treated by curettage, the rest by amputation or resection he states that in the light of his present knowledge he would probably, treat all of these cases by curettage. In my own series of 8 cases of giant-cell sarcoma of the radius, amputation was not performed in a single case. Personally, I have long been a believer in the conservative treatment of sarcoma of the long bones, especially of the central group, and in a monograph on the subject, published in 1910 (Journal A M A, vol lv p 333), I made the following statement

"Coming to sarcoma of the tibia, fibula, and radius and ulna, particularly of the myeloid type, in place of amputation as formerly advised and still advocated by the great majority of surgeons, we can safely substitute either curetting or partial resection, followed by a thorough course of the mixed toxins. While good results have been obtained from operation alone in a very limited number of cases in this group, I am convinced that the number of successes will be greatly increased by combining the toxin treatment with conservative operations, as I have suggested, and my series of cases strongly supports this opinion."

In 1905 I treated an extensive giant-cell sarcoma involving the lower third of the tibia by repeated curettage followed by prolonged toxins and X-ray. The leg

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was saved, and I showed the patient before the New York Surgical Society on November 14, 1923 eighteen years later, in good health and with complete restoration of function

The only point on which I differ from Bloodgood is, that while he believes that all giant-cell tumors are benign and only locally malignant, I believe that a certain number are definitely malignant and cause death by metastases, and that it is not always possible to differentiate the benign from the malignant especially in the early stages of the disease

According to Bloodgood, exploratory incision and curettage do not increase the malignancy of the local growth of the giant-cell tumor, and he believes this fact to be of great importance in justifying the less radical procedures, with this opinion, I am in complete accord

In his original article, published in 1910, Bloodgood reported 18 cases, all of which had remained well. It should be noted that fifty per cent of these giant-cell tumors occurred in the lower end of the radius, only one (of this group) was treated by curettage and the remainder by amputation. In the entire 18 cases, only 6 were treated by curettage, 4 by resection, and the remainder by amputation. In other words, in 1910 amputation or resection was the method of choice and curettage was only rarely employed. In Bloodgood's later series of cases published in 1919, in 10 femur cases, resection was employed in only one case, and the others were treated by amputation. In his later paper, Bloodgood calls attention to the case of Dr. Frank Hinds a rather extensive giant-cell sarcoma of the lower end of the femur, treated by curettage plus zinc chloride, the patient completely recovered and was in good health twenty-one years later. This case, I believe, is the only one in literature in any way parallel to the two cases of sarcoma of the femur which I have reported, one well nine years, and the other, seven years, in which, any less radical operation than amputation was employed. The only point of difference is that in Hind's case, the joint was not involved, whereas in my two cases, there was extensive involvement of the knee-joint

Bloodgood, in his latest paper on The Conservative Treatment of Giant-cell Sarcoma (American Journal of Surgery, May, 1923) gives the result of treatment in 77 cases of giant-cell tumors personally observed or of which he has record, since 1899. It is interesting to note the methods of treatment employed: curettage in 42 cases, resection in 23 cases, and amputation in 12 cases. In the earliest series, in 1899, one case was treated by curettage, none by resection, and 4 by amputation, in a series treated in 1909, 0 cases were treated by curettage, 3 by resection, and 4 by amputation, and in the 1920 series, 14 cases were treated by curettage, 3 by resection, and 2 by amputation, in other words, there has been a slow and steady movement to substitute conservative treatment for amputation which was almost universally employed in the earlier years

Bloodgood's series of 77 cases, apparently, showed no mortality, in the 42 cases treated by curettage, 26 were apparently cured by the primary opera-

tion, and 16 showed recurrence, of these 16 recurrences, 6 were treated by resection, and 4 by amputation

Bloodgood asks the question, why so many surgeons still treat central giant-cell tumors of the long bones by amputation, and he answers this question in the following way "Because in the majority of cases, then pathologist colleagues looked upon the tumor as malignant and called it sar-

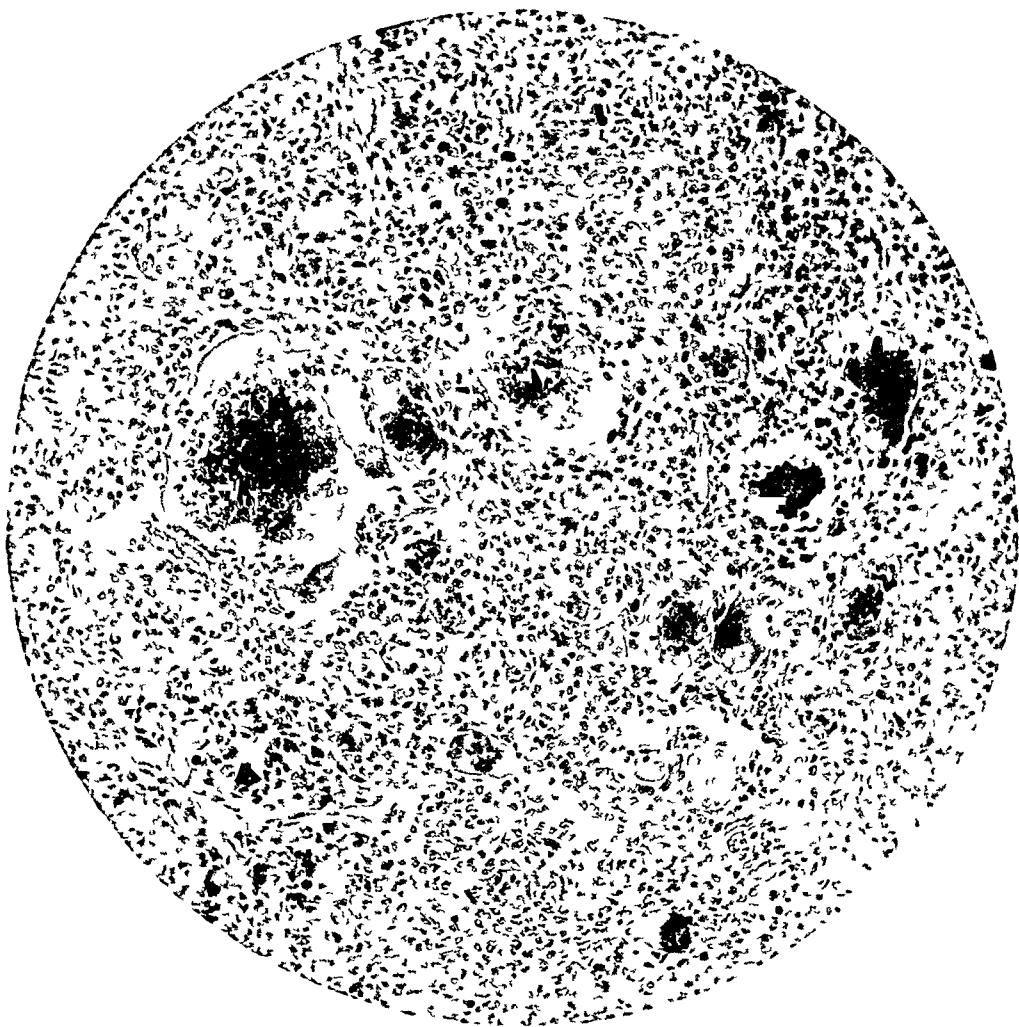


FIG 7—(Case No 3 in text)

coma, and because they have always been able to give an example of tumors which they claimed to be identical and which caused the death of the patients from metastases to the lungs and when the cases came to autopsy, they found giant cells in the metastatic tumors" He then cites a case in point, *i e*, amputation for a central tumor of the tibia by Codman in 1910, pronounced giant-cell sarcoma by Wright (Pathologist to the Massachusetts General Hospital), the patient died of metastases one year later He adds, that on subsequently reviewing the microscopic slide of this case, "we agreed that it was a malignant and not a benign giant-cell one"

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Here lies the crux of the problem—is it always possible for any considerable number of experienced pathologists to differentiate a benign from a malignant giant-cell tumor at the time of the primary exploratory operation or curettage? It is probably true that Bloodgood, who has made a special study of these cases for more than twenty years, may be able to make the diagnosis in the great majority of cases, but even he is not able

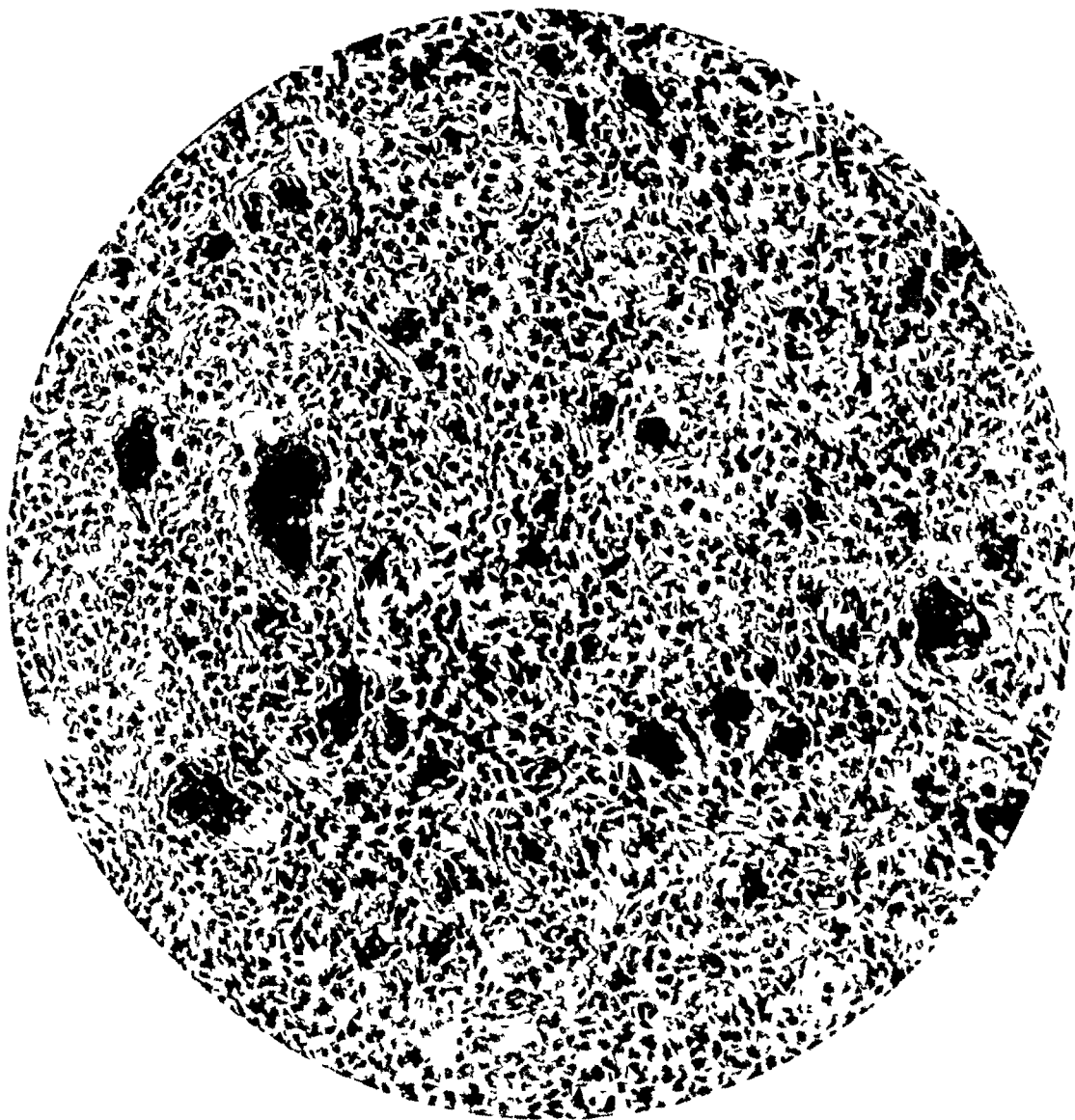


FIG 8—(Case No 3 in text)

to do so in every case, and I believe that there is a considerable number of cases in which the average pathologist still finds it difficult or impossible to differentiate the benign from the malignant type

It is quite a different matter to make the diagnosis at the time of operation, from making a diagnosis after the end result is known and the patient has died of metastasis or is alive ten years after operation

The paper on *Observations on Myeloid Sarcoma, with an Analysis of 50 cases*, by (Dr Matthew J) Stewart, Pathologist to the Leeds General

Infirmery and now Professor of Pathology, Medical Department, University of Leeds (*Lancet*, November 28, 1914), represents one of the most important studies of the subject. After summarizing the current views on myeloid sarcoma, the author gives an analysis of fifty cases observed at the Leeds General Infirmery during a period of fourteen years. In every one of these cases, the diagnosis was confirmed by microscopical examination of the tumor, and in forty-five cases, the pathologist's report was verified by Stewart



FIG 9 —(Case No 4 in text) November 1923

It is important to note that in thirty-five of the fifty cases, the site of the disease was the jaws, which tumors have long been recognized as practically benign, and in only eleven cases did the disease occur in the long bones, and in four cases in other localities. Confining ourselves to the long bones in which we are particularly interested, we note that in six cases the disease occurred in the femur, in four cases in the lower end, and in two in the upper, in three cases it occurred in the humerus, in two in the lower end, and in one in the upper, in one case, it occurred in the upper end of the tibia and in one case in the upper end of the radius. As Stewart points out, these facts furnish a striking contrast to Bland-Sutton's

view that the tibia is the favorite site of the disease in the lower limb, and the radius, in the upper. To the eleven long bone cases of his own series, Stewart has added ten long bone cases collected by Gask from the St Bartholomew's Hospital records, covering a period from 1902 to 1911, and twelve other cases collected by Maybury from the St Thomas' Hospital records, covering a period from 1901 to 1911, making a total of thirty-three long bone cases. In all of these, the diagnosis was confirmed by microscopical examination. The locality is shown as follows:

Femur, 19 (17 lower end and 2 upper end) Tibia, 5 (all upper end)
Humerus, 4 (2 upper end and 2 lower end) Radius, 4 (3 lower end and 1 upper end)
Fibula, 1 (upper end) Total, 33

In other words, in more than half of the number of cases the disease occurred in the lower end of the femur. In my series of 50 cases, 22 occurred in the femur, 19 in the lower end and 3 in the upper end. In striking contrast to this is

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Bloodgood's series of 18 cases, in which, in ten cases, the disease occurred in the lower end of the radius

As regards the age in Stewart's series, the youngest patient was twenty-one years old, and the oldest, fifty-one years

In analyzing fifteen cases of his own series, exclusive of the jaw, Stewart states that, of eleven cases which it was possible to trace, nine are living, one has had a recurrence, and one died. The latter case was a man with a myeloid sarcoma of the upper end of the femur, diagnosis established by exploratory operation, operation advised but refused, the patient lived for five years, the growth ultimately fungating in several places, but there was no clinical evidence of metastases. Seven of these cases were treated by local removal of the growth, and seven by immediate amputation, of the latter, only four cases were traced, all of which were alive and well. Of the seven cases treated by local removal, three have remained well, and in three, the disease recurred, of the latter, one was treated by local removal, one by amputation, and the third had a recurrence at the time of writing.

Taking Stewart's cases as a whole, including the thirty-five jaw cases, of forty cases in which it was possible to trace the end result, thirty-eight were alive at the

time of writing, thirty-one having remained well over three years. In the two cases that died, one had a fungating tumor of the thigh, and the other developed an independent infection. There was no evidence of dissemination in any case.

In collecting this material, Stewart found five cases of what he describes as examples of *malignant giant-cell sarcoma*, to which he has added a sixth case seen in private practice. Four of these were long bone cases, all were treated by amputation, and all died from six months to three years later of lung metastasis. In only one case was an autopsy made. These cases show the importance of being able to differentiate the benign giant-cell tumor from the malignant giant cells, which is usually of a very high degree of malignancy. Thus, Stewart believes it is possible to do. He states, "The histological diagnosis is based on the morpho-



FIG 10—(Case No 4 in text) May, 1923. Benign giant-cell sarcoma of humerus, developed metastases in radius and extension of disease in pectoral region, condition hopeless

logical characters of the giant cells, especially as regards their nuclei. In myeloid sarcoma the latter are numerous, uniform, small, and without mitoses, in malignant giant-cell sarcoma they are few, sometimes single, irregular, and often very large, while mitotic figures are frequent."

It would be interesting to know whether the malignant features of these six

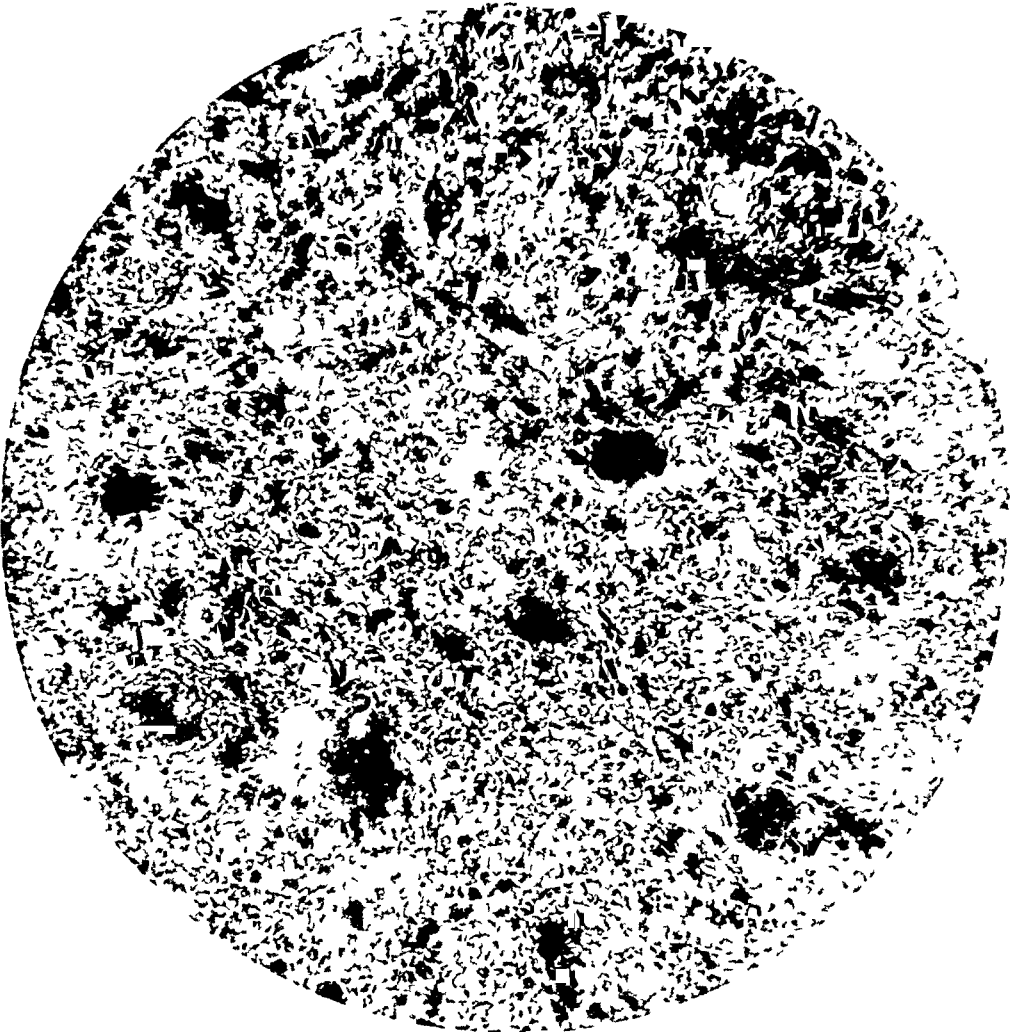


FIG 11 —(Case No 4 in text)

cases were recognized at the time of operation or not until the end result was known

In a later paper on *The Histogenesis of Myeloid Sarcoma* (*Lancet*, November 25, 1922), Stewart gives us the results of another careful study of the subject based upon nine years of added experience. He states, "Myeloid sarcoma (myeloma, sarcome a myeloplaxes) is one of the best recognized and most sharply defined of clinical and pathological entities. Its anatomical characters both gross and microscopic, are, in the great majority of instances, clean-cut and unmistakable, and at the present time there is almost complete unanimity of opinion as to the clinical behavior and appropriate treatment of the lesion." Maintaining that these tumors are only locally malignant, Stewart disagrees with Bloodgood, who takes them out of the group of sarcoma and classifies them as benign giant-cell tumor,

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and also with Barrie, who characterizes them as a type of hemorrhagic osteomyelitis. Stewart believes that the name "myeloid sarcoma," as introduced by Paget nearly seventy years ago on account of the naked-eye resemblance of the tumor to red marrow, is the best name to apply to this group of tumors, and that since none of its constituent cells is derived from specific bone-marrow cells, the name "myeloma" is inaccurate and should be dropped. While Stewart still adheres to his original opinion that "myeloid sarcoma" is only locally malignant, he states

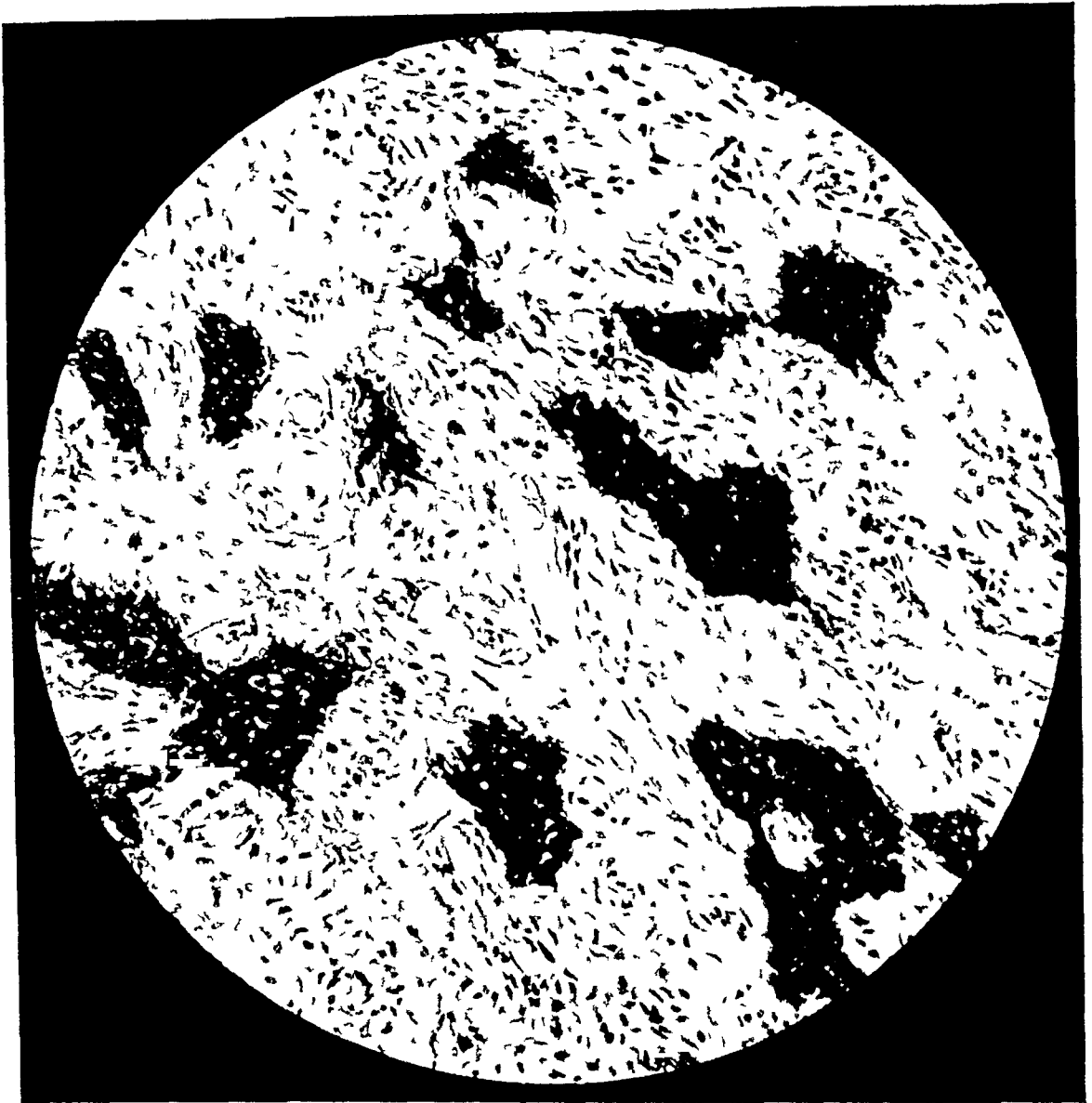


FIG 12 —(Case No 7 in text) Sarcoma of humerus, giant- and spindle-cell of epulis type. Amputation, local recurrence probable lung metastases, death 3 months later

that in the discussion that followed his communication, Dr Archibald Leitch mentioned that he had seen a genuine case of myeloid sarcoma with metastases. The structures of the secondary deposits was similar to that of the primary growth, and included typical, osteoclast-like giant cells. This case, he believes affords strong confirmation of some of the views expressed in this paper, notably (1) that the tumor is essentially a sarcoma, albeit of only local malignancy in the great majority of cases, and (2) that the giant cells are not fortuitous but a constant and integral part of the growth.

OCCURRENCE OF METASTASES IN CASES OF GIANT-CELL SARCOMA
OBSERVED BY OTHER SURGEONS

Gross, in his well-known monograph on *Sarcoma of the Long Bones*, published in 1879, took issue with the position held by Nelaton, that these cases of giant-cell sarcoma were always benign, and he reported five cases from the literature, in which metastases had occurred



FIG 13 —(Case No 12 in text) Benign giant-cell sarcoma of radius treated by curettage and carbolic acid recurrence, toxin treatment, disappearance recurrence, radium treatment steady increase in size toxin treatment, improvement recovery Picture taken in November 1919 before treatment

Auge and Roux (Bull de l'association franc pour l'etude du cancer, 1922, 11, 616) report a case of giant-cell tumor of the femur, amputation, recurrence, generalization in two months This tumor was supposed to be a myeloid sarcoma of the lower end of the femur The patient, a man of twenty-two years, gave a history of having had pain for two months, following a fall, and a swelling which was noticeable only ten days before admission to the hospital X-ray examination showed a slight, fusiform, epicondylar swelling of the bone, the continuity of which was intact The patient was pale, emaciated and febrile A clinical diagnosis of osteomyelitis was made A spontaneous fracture developed about one week later A sub-trochanteric amputation was performed without preliminary exploratory operation Histological diagnosis "tumeur a myeloplaxes" (Nelaton's term for a giant-cell sarcoma), and a benign prognosis was made The wound healed by primary union At the end of two months, the patient had an attack of what was thought to be pulmonary influenza On re-admission, a recurrent nodule was found in the amputation scar, and there were definite symptoms of pulmonary metastases, death occurred one week later Fortunately, a post-mortem examination was made, the lung was found to contain numerous hemorrhagic nodules or growths, together with commencing pericardial involve-

ment, the left kidney was almost completely replaced by tumor Microscopical examination of the primary tumor showed very many typical multinucleated giant cells, including many enormous forms with innumerable nuclei, these seemed to be most abundant where there was necrosis and hemorrhage, and occurred chiefly in the central part of the tumor The mixed cell ground-work was composed of cells which showed great variety both in size and shape, there were many mitotic figures Nearly all of the nodules from the lungs and the secondary deposits in the kidneys showed numerous multinucleated giant cells (one tiny nodule in the lung showed no giant cells) The authors conclude that the mere presence of giant cells in this type of tumor of the long bones, does not necessarily carry with it the benign prognosis of a "tumeur a myeloplaxes" If this term is used, it must

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be kept in mind that forms exist where clinical malignancy shows itself by generalization, and where the giant cells have a diversity of form and are of atypical character

Stewart (to whom I am indebted for a very complete abstract of the case), in a careful review of it, states "In so far as it is possible to judge from a careful description and four excellent drawings, I am of the opinion that the case here described is one of myeloid sarcoma (myeloma, tumeur a myeloplaxes), but one in which anaplasia is unusually well marked. The giant cells are of osteoclastic type, and are in profusion in both the primary and secondary growths. They are quite as numerous as in most myeloid sarcomas. Their complete absence from one tiny nodule in the lung can be explained on an anaplastic hypothesis, none of the young, very actively-growing cells having as yet differentiated into osteoclasts * * *. The practical conclusion is that there occur cases, clinically and pathologically indistinguishable from ordinary myeloid sarcoma, in which an unusually high grade of malignancy exists, including even the power of dissemination. Such cases are obviously of rare occurrence, but the possibility should be borne in mind by surgeons."

Oertel (Professor of Pathology, McGill University), at a meeting of the Interurban Orthopaedic Society in Montreal a year ago, reported a case of giant-cell sarcoma of the femur, in which death occurred from metastases. Doctor Oertel has very kindly sent me a few notes of this case with photographs of the gross and microscopic specimens. This patient, a man of forty-one years, was amputated for what, on histological examination, proved to be a typical giant-cell tumor of the epulis type of the lower epiphysis of the femur. The leg was primarily amputated, not only for the tumor, but for a suspected thrombosis of the femoral vein. However, the amputated leg itself did not show, and did not include, the thrombosed part, this was found later, at autopsy, higher up, it was

in this connection that a metastases of the growth in the wall of the vessel was found, a considerable distance above the original growth. According to Oertel, it was probably this lesion of the vessel wall which gave rise to formation of a thrombus in this situation and from this, subsequent thrombus extension into the vena cava inferior and terminal pulmonary artery embolism took place. About the metastatic nature of the growth in the vessel wall, Oertel believes there can be no doubt. It was distinctly nodular and definitely inserted into the vessel wall, so that it could be readily differentiated, and separated from the organizing thrombus in the lumen. The histological picture also is in exact conformity with the primary growth, although the cell contents are here somewhat more embryonic than in the original. The accompanying giant cells in the metastasis were numerous, as in the primary growth, and quite typical in appearance. No other metastases were found, and the termination through pulmonary embolus ended life abruptly.




FIG 14 —(Case No 12 in text)
October, 1920, after four months radium
treatment

Oertel concludes that this case is another example of how careful one must be in making prognoses from histological sections alone. While he agrees with those who regard the epulis type of tumor, generally speaking, as local lesions, he believes it should always be borne in mind that they are, after all, very unbalanced embryonic tissues and that they may give rise, when, as in this instance, they break into veins, to tumor extension and possible metastases.

NOTE This case has been published in full detail in the *ANNALS OF SURGERY*, December, 1923, by Doctors Waugh and Turner.

Shattock, Professor of Pathology, St. Thomas' Hospital, Medical School and Curator of the Museum of the Royal College of Surgeons in his *Pathological*

Remarks on Sarcoma of the Long Bones (The British Journal of Surgery, 1923, vol. xi, p. 127), states "Some of the giant-cell tumors of bone are distinctly malignant and produce metastasis—a fact fully recognized by Sir Henry Butlin."

Morton of the Yale Medical School, in an admirable article on *Generalized Types of Osteitis Fibrosa Cystica* Archives of Surgery, 1922 has tabulated all the cases of this rare disease that he could find in literature, and he divides them into two groups: (1) without giant-cell sarcoma, (2) with giant-cell sarcoma. Of the first group, containing 36 cases, 12, or thirty-three per cent, died; of the second group, containing 26 cases, 15, or fifty-eight per cent, died. In other words, in the group the cases in which there was a pathological diagnosis of giant-cell sarcoma, the mortality was nearly double that in which no giant-cell sarcoma was found. It would seem possible that we were dealing with multiple or metastasizing giant-cell sarcoma in the one



FIG 15 —(Case No. 12 in text) October 1920

group instead of the ordinary Van Recklinghausen disease, osteitis fibrosa cystica.

In spite of this group of cases, Morton is of the firm belief that giant-cell sarcomas are benign, and he adds that there is abundant histological and clinical evidence at hand now to firmly establish the benignity of these giant-cell growths, furthermore that they grow locally only do not metastasize, recur only on incomplete removal and may be removed by local operation several times if necessary.

Gibbon, of Charlotte N. C. (Journal of Bone and Joint Surgery, July, 1922, p. 512), reported a case of sarcoma of the femur in a boy, sixteen years of age, in which the clinical and X-ray diagnosis was giant-cell sarcoma. The case was first treated by curettage. The gross specimen closely resembled giant-cell sarcoma. A specimen of the tumor was sent to Bloodgood, and another portion to Crawford, of Philadelphia. Bloodgood stated in his report "Your description

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of the gross tumor is that of a giant-cell tumor, but there is a sarcoma, fortunately rare, which resembles much a giant-cell tumor in the gross, and I fear that your tumor belongs to the sarcoma group" Doctor Crawford reported "giant-cell sarcoma" The tumor recurred before the reports of the pathologists had been received by Gibbon, and grew rapidly in size so that it was necessary to perform an immediate amputation While the patient was in good health at the time of his report, a personal communication from Gibbon, in May, 1923, stated that the boy had died in less than a year after the amputation of metastases in the lungs

Morton and Duffy, of the Department of Surgery of the Yale University Medical School, have recently published an admirable article on Bone Sarcoma (*Archives of Surgery*, November, 1923) Although the paper is based upon a study of only ten cases, these cases are published with such complete, clinical, X-ray and pathologic data, that, what they lack in quantity is more than made up for in quality Some of their observations and conclusions are so well thought out and so practical that they are worthy of brief note

"We are impressed with the difficulties which confront the average surgeon in arriving at a correct diagnosis and in deciding on a proper treatment in any group of bone tumors There are so many exceptions to the rule, that each case must be most completely studied and weighed before action is taken Were we to trust to the Rontgen-ray picture for the diagnosis we would in many instances be wrong Were we to depend upon the microscopic sections alone, especially at the time of operation, we would be often misled"

Case No 8 of their series is of special interest inasmuch as it was a giant-cell tumor in which it was extremely difficult to decide either for or against malignancy, much of the evidence, both from the gross appearance and the microscopic sections, being uncertain and conflicting From a study of this case, they conclude

"Therefore, it would seem that in a definite group of giant-cell tumors, malignancy must be recognized, in which the clinical features and Rontgen-ray findings must have great weight in determining the diagnosis" This shows that Morton's opinion has been somewhat modified by further experience

I cannot agree with their conclusion that, when the tumor is of very rapid growth and had progressed extensively when first seen, that other measures such as X-ray or radium, at least until we get more information, would seem to meet the situation better than radical amputation of the part It seems to me that the treatment of this group of cases furnishes, perhaps, the most difficult problem of all The very fact that the tumor is of rapid growth, in my opinion, is a proof positive that it is of a high degree of malignancy The only hope of saving the life of the patient in this group, I believe, lies in amputation at the earliest possible moment, following this with prophylactic treatment

One of the most recent and practical discussions of the diagnosis of bone tumors is found in an editorial note following a review of Tumors of Bones, in the Twentieth Report of Progress in Orthopædic Surgery (*Archives of Surgery*, May, 1923, vol vi, pp 858-908) by Robert B Osgood and collaborators

"Differential diagnosis of bone tumors is far from certain by any known method, particularly roentgenoscopy. This is altogether natural when we remember that even with the gross specimen before him and the slide under the microscope, the pathologist is often uncertain as to its character. Often there is such widespread involvement of the bone that it is impossible to determine the point of origin or the invasion. While in sympathy with any effort to systematize the diagnosis, we are under the impression that the one point of importance is whether the growth is benign or malignant, and that the best way to determine this is by immediate exploration and pathologic examination. The relation of the region to

be examined is also of importance, and occasionally the surgeon well trained in gross appearances in malignant disease must be governed by his finding quite as much as by the report of the pathologist, made necessarily somewhat incompletely at the time of operation.'

Treatment Exploratory operation

We very strongly disapprove of the present tendency to forego exploratory operation in tumors of the long bones, and believe that the disadvantages of exploratory operation have been unduly emphasized by the pathologists, thereby making the surgeons less and less inclined to avail themselves of this most important aid in diagnosis. The greatest objection to exploratory operation is the supposed danger of causing generalization of the disease from cutting into the tumor. That this danger is largely theoretical is shown by the fact that the great majority of cases of sarcoma of the bones that have been cured were cases in which exploratory operation had been performed. In these cases at least the operation did no harm. Furthermore, Wood has shown that biopsy in a



FIG 16 — (Case No 12 in text)
January 29 1921

large series of animal tumors has shown no greater percentage of metastases in cases in which an exploratory operation was performed than in cases in which this step was not taken. Another disadvantage claimed is the possibility of infection occurring in the exploratory incision. Infection in modern surgical technic should be a very rare occurrence. We have on two occasions curetted an extensive giant- and spindle-cell sarcoma of the lower end of the femur with involvement of the knee-joint, and kept it clean with Dakin's fluid until the wound had entirely healed, without infection, the patient was then given toxin- and radium-treatment, and is now living, with a useful limb, more than seven years later. Another similar case, with extensive knee-joint

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involvement, treated with exploratory operation without curetting, followed by the use of the toxins alone, is well nine years later, this case was treated before the introduction of Dakin's fluid

Without an exploratory operation, it is impossible to make an accurate diagnosis in a considerable number of cases, and unless an accurate diagnosis is made, the proper method of treatment cannot be employed sufficiently early to save the life or limb. In the giant-cell group of long-bone tumors, we would never do a simple exploration, removing a small portion of tumor for diagnostic purposes, but would perform a thorough curettage as soon as possible. I agree with Bloodgood that there is nothing to be gained by preliminary radium or X-ray treatment. Removal of all of the tumor by curettage gives the best chance of making a correct diagnosis from the microscopic section, and at the same time is the best method of treatment.

There is at present no uniform method of treatment of giant-cell sarcoma. Immediate amputation, which was the routine method of treatment a decade ago, is seldom done at present. Curetting with the application of carbolic acid, the method advocated by Bloodgood in 1910, is probably, more largely used than any other method. Ewing, however, in his article on Bone Sarcoma in the *Archives of Surgery*, May, 1922, criticizes the standard method of treatment (curettage followed by some escharotic) on the ground that infections so frequently follow curettage, and lead to prolonged suppurative osteomyelitis and septicæmia, or the tumor recurs and requires repeated curettages with an advancing destruction of bone or opening into joints so that eventually amputation is required. He states that he "has observed many cases in which all of these unfortunate terminations have resulted in the hands of competent surgeons, nor is it unreasonable to assume that the trauma of repeated curettages may transform an originally benign process into one clinically malignant. Even the mechanical forcing of viable cells through open blood-vessels and the production of metastases, seem quite within the range of possible results of surgical trauma, especially so in cellular tumors." Ewing would give up curettage entirely and substitute routine treatment with X-ray and radium, by which, he states, all these hazards may be avoided. Ewing cites the results

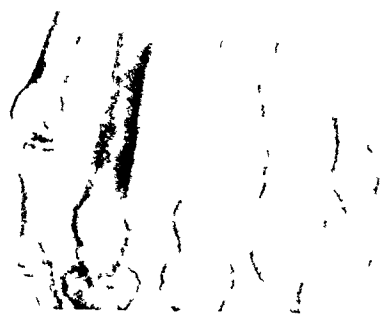


FIG. 17 — (Case No. 12 in text)
July, 1921

of treatment of giant-cell sarcoma at the Memorial Hospital in support of his opinion

Before giving up curettage and other conservative operations, for X-ray or radium alone, we should examine carefully (1) all the available data to determine, if possible, how frequently these untoward results that Ewing mentions occur in actual practice, and (2) the end results thus far obtained by radium and X-ray

The statistics of Greenough, Simmons and Harmer, show 12 giant-cell sarcomas treated by operation, by curettage 7 cases, resection in 2 cases amputa-

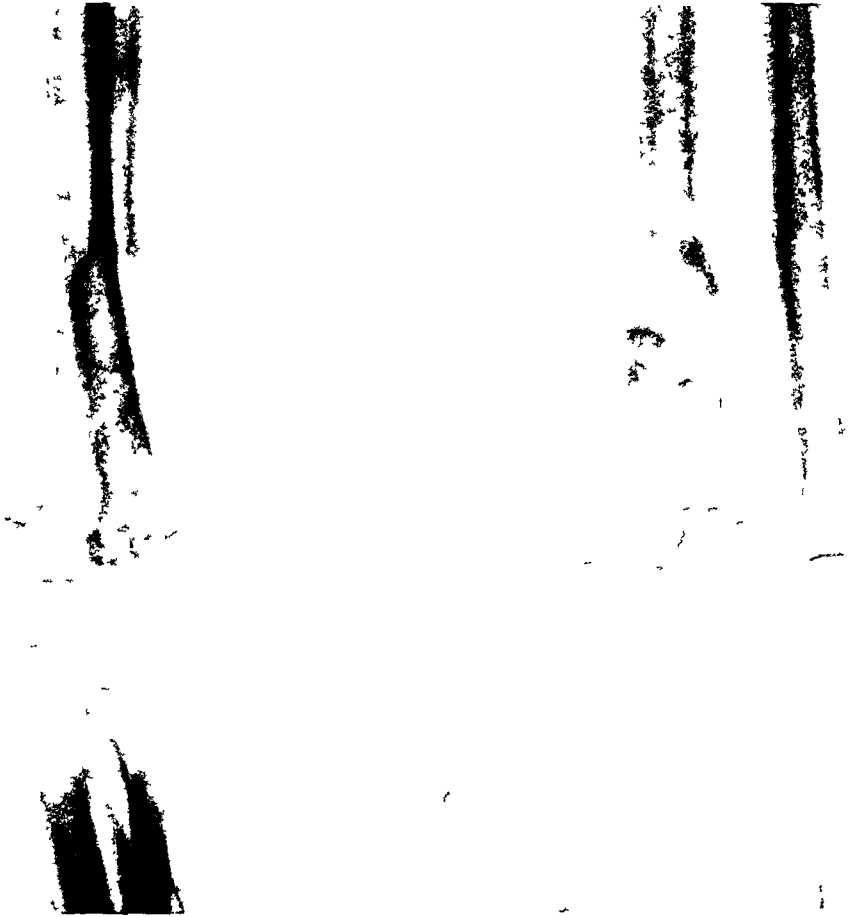


FIG 18 — (Case No 12 in text) October 1921 one year after toxin treatment

tion in 3 cases with only one death from operation in a very extensive case Bloodgood, certainly could not have found any large percentage of these bad results, or he would have called attention to the fact in his numerous publications His latest series of cases show 46 treated by curettage with no deaths An analysis of my own cases shows no case of osteomyelitis following curettage or exploratory operation, and no case of septicæmia Delayed closure of the sinus with subsequent infection did however, occur in 3 of our cases, in two of these the exploratory operation and curetting had been done at other hospitals, and in one bismuth paste had been

PROGNOSIS IN GIANT-CELL SARCOMA

introduced into the cavity, which greatly delayed the wound healing and made amputation necessary a year later. In one case, a severe infection occurred a few weeks after operation, requiring amputation. In both of these cases, the condition was an extensive giant-cell sarcoma of the femur, and in both cases, amputation would have been advised by the majority of surgeons as the best primary method of treatment. Again both of these cases occurred before Dakin's fluid had come into use, which, probably, might have made amputation unnecessary. So that 3 out of nearly 50 cases would seem a very small proportion to justify the



FIG 19 — (Case No 12 in text) March 1923

surgeon in abandoning curettage or even exploratory operation to determine the nature of the tumor. Certainly, before giving up the surgical treatment of giant-cell sarcoma, we should first be in possession of some convincing evidence that X-ray or radium will cure not only an occasional case of giant-cell sarcoma, but as large a percentage as surgical methods. So far, we have no data to show the relative proportion of cases cured by radium or X-ray compared with those cured by curettage alone or curettage supplemented by radium or toxins. Ewing cites one case in literature and the Memorial Hospital results. So far at the Memorial Hospital we have had but two cases of giant-cell sarcoma in which the diagnosis was confirmed by microscopical examination in which the patient has been cured and remained well for a period of over three years. (1) A small endosteal tumor, a benign giant-cell sarcoma of the upper end of the tibia, in which one dose of radium

was given a short time after curettage is well more than 4 years, (2) a benign giant-cell sarcoma of the lower end of the femur, in which radium was used after curettage, and the treatment kept up for nearly one and a half years, this patient is well now three years later ⁷ In both of these cases it should be noted that radium was not used alone but only subsequent to curettage and the application of carbolic acid Another case, in which X-ray was used in a probable giant-cell sarcoma of the upper end of the humerus, remained well for a period of nearly two years, and was then lost sight of, in this case, however, there was no microscopical examination and the diagnosis rested



FIG 20 —(Case No 13 in text) Giant- and spindle-cell sarcoma of femur with extensive involvement of entire knee-joint exploratory incision toxins complete recovery, patient well 9 years later

solely on the X-ray and clinical signs In several other cases in which the diagnosis rested upon clinical and X-ray evidence, the tumors have been apparently controlled and the patients are well at present, but none of these cases has gone beyond the three-year period

It is assumed that no bad results will follow the use of radium or X-ray in the treatment of long-bone sarcoma, and yet there is good reason to believe that if we could get a careful follow-up of all the cases treated by X-ray or radium, we should find untoward results quite as serious as those that have been observed following curettage Only recently we have had to perform amputation of the thigh in the case of a benign giant-cell sarcoma of the lower end of the femur in an adult, who had originally been treated at another hospital by X-ray after curettage and carbolic acid had been applied,

⁷ This patient has just suffered from a fracture of the femur just above the original site of the tumor from a fall

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in October, 1921, he had six X-ray treatments, he was admitted to the Memorial Hospital in December, 1921, and had one radium treatment at that time, a second one was given in March, 1922, and a third, in October, 1922 (total of 71,895 mc hours). In the early part of 1923, a small ulcerated area developed just above the condyle, which slowly increased in size, and was accompanied by very severe pain. During the last eight months, there has been a gradual atrophy of the soft parts above the knee, accompanied by progressive fibrosis, the pain has steadily increased in severity, requiring large doses of sedatives, amputation was performed in October, 1923. Examination of the femur after removal showed that the sarcoma had been entirely cured, and replaced by a small cyst. The amount of radium used in this case was less than one-half that used in other long-bone cases without harm.

Bancroft (Clinics of North America, December, 1921, p 1747) reported a case of giant-cell sarcoma of the lower end of the radius, in which osteomyelitis developed following X-ray and radium treatment, 100 mg of radium were implanted in the cavity for five hours, after the second curettage on April 3, 1918. The cavity was then filled with bone wax, X-ray was used following the radium treat-

ment. A severe X-ray burn occurred and the hand had to be kept in extension for several months. The condition was such that amputation was advised, at another hospital, but the patient refused. In December, 1919, one and one-half inches of the lower end of the radius and ulna were resected. During this period, the hand was practically useless. On May 2, 1921, a fourth operation was done, following which, the patient's condition was considerably improved, and she was able to perform her ordinary work without pain.

Although the theoretical discussion of the question of whether giant-cell sarcomas are benign or malignant is most interesting, the practical side of the question is of far greater importance. The surgeon has charge of a patient who is suffering from a central tumor of the bone. A careful clinical



FIG 21 —(Case No 13 in text) Showing nature's attempt to form a new condyle

history, followed by a thorough physical examination will, in many cases, enable him to make an accurate diagnosis. This should always be supplemented by an X-ray picture, which will usually furnish additional aid of great value. In many cases, however, an accurate diagnosis cannot be posi-

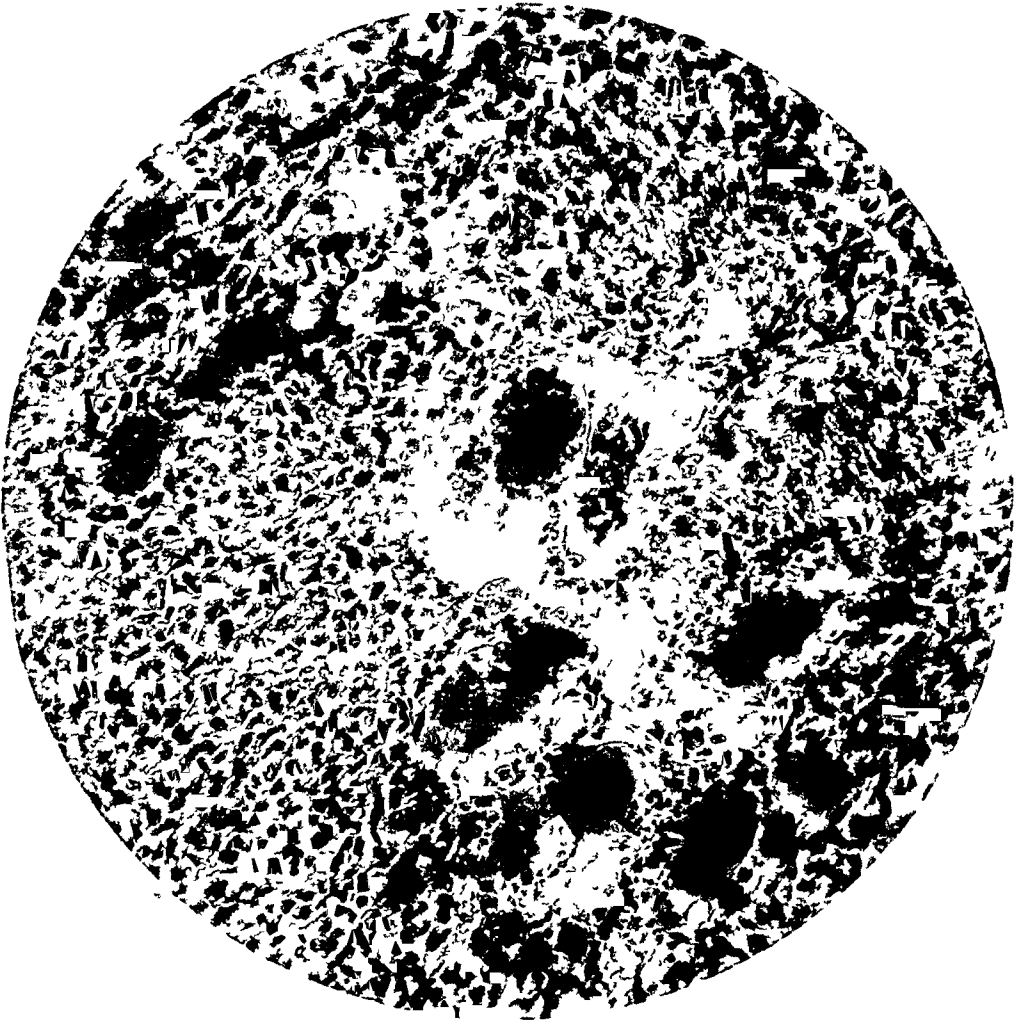


FIG. 22 —(Case No. 13 in text.)

tively made without a microscopical examination by a competent pathologist, and in a few cases not always with a microscopical examination.

If we are dealing with a small endosteal tumor of slow growth, with an X-ray picture typical of a giant-cell sarcoma, and a microscopical examination likewise showing the characteristic structures of this tumor, simple curetting followed by the application of carbolic acid may be sufficient to cure the disease. Bloodgood has demonstrated that in many instances a cure can be effected by this method. Simple curetting, however, is often followed by a recurrence of the tumor, as Nelaton has pointed out in his monograph, and he recommended, in addition the application of strong

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solution of zinc chloride. I have seen a number of cases in which curetting and carbolic acid had little effect, and the operation was followed by rapid local recurrence and Stewart's cases show the marked tendency to recurrences after curettage. In advanced cases, resection has been employed with implantation of bone graft. In my experience, in far advanced cases, the disease can be often entirely eradicated by curetting followed by the use of the mixed toxins of erysipelas and bacillus prodigiosus alone, or combined with X-ray or radium, and in these cases the regeneration of bone has been sufficient to restore the normal function of the limb without the introduction of bone grafts. In a number of cases the disease has entirely disappeared under systemic injections of the mixed toxins alone, and in several cases it has disappeared under radium following curettage, so that we have several methods of controlling giant-cell sarcoma before resorting to amputation. In my series of cases, amputation was performed nineteen times, in only ten cases as a primary measure, and in nine cases, after failure to control the disease by conservative methods of treatment.

There are at present at the Memorial Hospital a number of cases of giant-cell sarcoma under treatment by X-ray and radium. Most of these cases are showing improvement. There has been no exploratory operation done in these cases, and therefore, no microscopical examination has been made, the diagnosis resting entirely upon the clinical and X-ray evidence. The gradual replacement of the destroyed portions of bone by calcium salts has been




FIG 23 — (Case No 14 in text) Giant- and spindle-cell sarcoma of femur which had broken through the bony shell, involving the soft parts, extensive invasion of the knee-joint and upper end of the tibia. Treated by curettage, toxins and radium.

regarded as a favorable X-ray or radium reaction. In none of these cases, however, has the tumor disappeared and the patient remained well for a sufficient length of time to justify one in regarding him as cured. Therefore, in our opinion, at the present time we have no results in the treatment of giant-cell sarcoma to justify the substitution of radium or X-ray as a method of choice, in preference to curettage supplemented by prophylactic toxins and radium or X-ray. A considerable number of permanent cures have been obtained by the latter method, which method has the advantage of greatly shortening the period of treatment and the consequent disability. While it is true that the diagnosis of giant-cell sarcoma of the long bones can be made by clinical and X-ray evidence alone in the majority of cases,

there is a chance of error in about thirty-three per cent of the cases Doctor Herendeen found that in twenty-four cases in which the diagnosis of giant-cell sarcoma was made on clinical and X-ray evidence, the subsequent history of the case showed that the diagnosis was wrong in seven cases

There have recently been observed at the Memorial Hospital two cases which illustrate very well the disadvantages of relying upon the clinical and X-ray evidence for a diagnosis in long-bone tumors, (1) patient had been treated for nearly six months elsewhere as a case of productive osteitis of the

tibia, this was the opinion of many expert surgeons and X-ray men who had seen the case, at the end of six months when it became evident that the trouble was a malignant tumor rather than osteitis, amputation was performed, but it was too late to save the life of the patient, (2) a tumor of the upper end of the femur which, from the clinical and X-ray evidence, seemed undoubtedly a giant-cell sarcoma of the benign type, after eight months' treatment, with little improvement, exploratory operation was performed with curetting, the tumor



FIG 24 —(Case No 14 in text) Patient well 7½ years later

proved to be a degenerating chondroma or a chondro-sarcoma (Doctor Ewing's diagnosis) , by this time the patient's general condition was so poor that an amputation was no longer possible

I believe that the question of whether radium or X-ray is the best method of treating giant-cell sarcoma of the long bones should still be regarded as subjudice Doctor Herendeen, at the Memorial Hospital, is making a very careful study of the effect of the high-voltage X-ray machine in a series of these cases, and we are also using radium in another series of cases but sufficient time has not yet elapsed to determine the end-results Dr Robert Abbe, I believe, was the first one to point out the very remarkable effect of radium on a giant-cell sarcoma of the jaw, in which case the jaw was completely restored in form and function and the patient remains in good health twenty years later (published with illustrations in the *Medical Record*, 1893-4) The treatment of giant-cell sarcoma of the long bones, however,

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is, in my opinion, a much more difficult problem than that of the jaw. If it can be proven that better or even as good results can be obtained with radium or X-ray than by curettage and escharotics followed by toxins or radium, I am very certain that the surgeon will be only too glad to substitute X-ray or radium as the method of choice.

We believe that Bloodgood's latest statistics furnish convincing evidence of the efficacy of the plan of treatment which he advocates, *i e.* immediate and very thorough curettage, washing out the cavity with carbolic acid, alcohol and zinc chloride (50 per cent solution), and if the frozen section shows any evidence of sarcoma, introducing radium needles at the time of operation, leaving the wound open for subsequent study of the tissue filling up the cavity, and for further treatment if necessary. The introduction of radium needles, we believe, unnecessary and may perhaps lead to infection.

In regard to the use of radium alone in these cases, Bloodgood states

"My personal observations in a few cases do not confirm the view that radiation is a specific therapy for giant-cell tumors."

Kelly reports a case of a tumor of the lower end of the radius which had recurred after two curettings, and prolonged radiation through intact bony shell had had no effect, a third curettage with introduction of radium was followed by apparent cure.

Bloodgood had another similar personal case. He states that Gaensler,

after a first curettage, introduced radium, "but we have no proof that the radium accomplished a cure in this case."

While we completely agree with Bloodgood on the method of conservative treatment of central tumors of the long bones, we are even more conservative than he is in that we not only abandon the use of amputation in these cases, but resection as well in a certain group which are clinically and microscopically benign. Furthermore, our series shows that the very considerable portion of bone that has been destroyed can be entirely repaired by Nature, with restoration of function, without any bone graft.

In addition to curettage and escharotics, we believe it advantageous to use the mixed toxins of erysipelas and bacillus prodigiosus, and radium pack, if available, but not until the cavity has nearly closed, thereby greatly decreasing the number of recurrences and hastening the recovery of the patients.



FIG 25 —(Case No 14 in text)

I believe it unwise to introduce radium tubes into the cavity of bone after curettage. In those cases, which clinically and microscopically appear to be malignant or probably malignant, we would use the same method of treatment, but if after a very few weeks, the disease is not controlled, we would then amputate, and follow the operation by toxin treatment. We believe that many lives are lost by prolonging conservative treatment in this type of case which might be saved by earlier amputation. Up to the present time we have no evidence to prove that a single central malignant sarcoma of the long bones



FIG 26 —(Case No. 14 in text)

or a single periosteal osteogenic sarcoma has been cured by radium or X-ray alone, or even combined with curettage. Hence it would seem unwise to continue for any length of time radium and X-ray treatment in these cases, with the possibility and even probability of metastases developing during such treatment. Our opinion that earlier amputation should be performed in the malignant type of central sarcoma as well as in the osteogenic periosteal sarcoma group is supported by the fact that of 38 cases of sarcoma of the long bones treated by amputation followed by prophylactic treatment with the toxins of erysipelas and bacillus prodigiosus 22 of the

patients were alive and well from 2-28 years, 20 were alive from 3-28 years and 9 were alive and well from 9-28 years. Of these 22 cases, 4 were central giant cell (3 of the femur and 1 tibia) in which conservative treatment had been tried and failed, 18 cases were periosteal sarcoma (a microscopical diagnosis was made in every case), and of these, 17 were well from 3-28 years and one died eight years later of metastases in the lungs.

Treatment in Personal Series of Cases In the present series of cases, primary amputation was done in 11 cases, it would seem good evidence that conservative treatment was not indicated in most of these cases from the fact

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that seven of the patients later died of metastases, one, six years after amputation, of the others two are living, one, twenty years later, and one, six years later. Amputation was employed in eight other cases, but not until conservative treatment had been tried, in two of these cases amputation was done for infection, after the disease has been apparently controlled and in one, for the severe pain associated with radium burn. In one case, a giant- and spindle-cell sarcoma of the lower end of the femur,

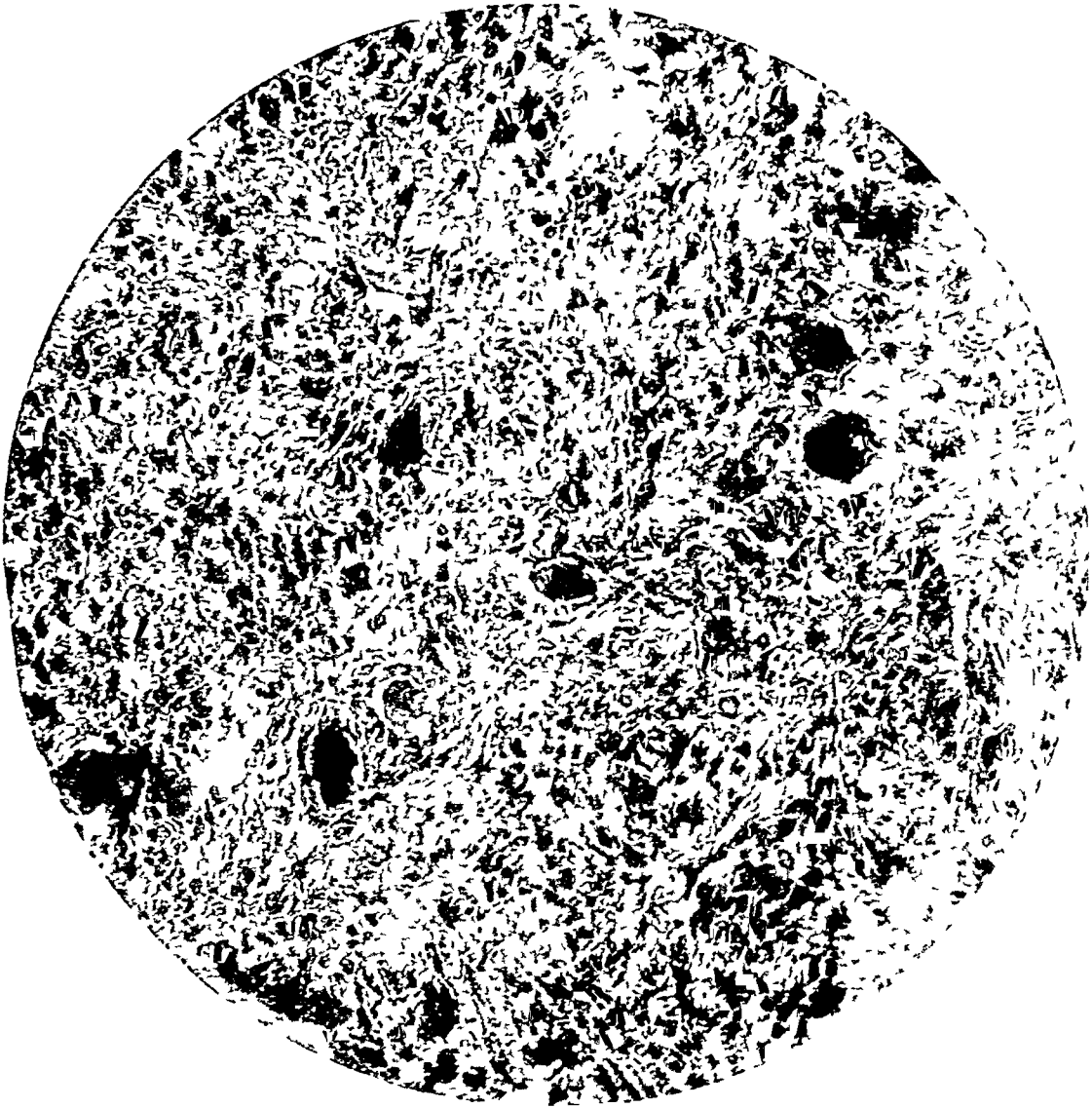


FIG 27 —(Case No 14 in text)

amputation was done more than a year after toxin-treatment had been given, when the disease was under apparent control, for an injury to the popliteal artery caused by spiculæ of bone from a pathologic fracture, the patient remained well more than ten years later. In four cases amputation was done after conservative treatment had been tried and failed, one of these cases was treated with toxins and curetting, with apparent recovery, recurrence took place eight months later, amputation, patient

well two years later The other three cases were treated with X-ray in one case, and radium in two cases, two died of metastases, and one is well at present, six months later

A brief explanation of the end-results in the eleven cases of giant-cell sarcoma treated by primary operation

- 1 T, male, extensive giant-cell sarcoma of lower end of femur (see case No 21 in Femur Table), amputation performed at the Chatham General Hospital, Ontario, Canada, followed by toxin treatment given under my direction The patient was well when last traced, six years later
- 2 R, female, central sarcoma of lower end of femur (see case No 20 in Femur Table) Amputation was performed twenty-two years ago by Dr Vander Veer of Albany, N Y, no prophylactic or other treatment was given later The patient came under my observation two years ago, for another trouble, at that time there was no evidence of a return of the sarcoma, twenty years after the amputation I obtained a slide of the original tumor from the Bender Laboratory, and it was pronounced a typical benign giant-cell sarcoma
- 3 B, male (see case No 1 in text)
- 4 F, female (see case No 7 in text)
- 5 W, female, central sarcoma of upper end of tibia, amputation by Doctor Bull in 1900, patient came under my care six years later, suffering from lung metastases The original tumor had been pronounced a giant-cell sarcoma by a competent pathologist, but Doctor Ewing, on reviewing the slides after the death of the patient, pronounced it a malignant giant-cell sarcoma, not the benign type
- 6 S, (see No 10 in text)
- 7 R, female, giant-cell sarcoma involving lower portion of shaft of femur (see case No 4, Femur Table) Amputation performed followed by toxin treatment, the patient remained well for nearly three years and then died of extensive metastases involving the bones of the pelvis and lungs
- 8 S, male, giant-cell sarcoma of tibia (see case No 6 in Tibia Table)
- 9 H, (see case No 5 in Humerus Table)
- 10 R, male, giant-cell and spindle-cell sarcoma of fibula, (see case No 9 in Radius Table)
Excision of very large tumor with entire fibula, wound treated by Keating-Hart fulguration before being closed, three days later, there developed extensive gas gangrene, for which I did an immediate amputation, good recovery, end result not known
- 11 Doctor P's case, (see case No 13, Tibia Table), sarcoma of upper end of tibia, amputation was performed, after which I was consulted as to further treatment The toxins were advised as a prophylactic measure, but the treatment was not carried out When last traced, several years later, the patient was still in good condition

In 7 of this group of 11 cases, metastases developed, in 3 of the cases (Nos 3, 4 and 7) the amputation was performed by myself, and in No 5, by Doctor Bull, so that I had an opportunity of studying the sections in only four cases of this group A microscopical examination was made in case Nos 3 and 4 by Doctor Ewing, in both of these cases, the tumor was of such rapid growth, and the clinical features so typically malignant, that I did an immediate amputation without exploration On reviewing case No 3, Doctor Ewing stated that it was a highly malignant telangiectatic sarcoma, and that his original report was an error in diagnosis In case No 4 the clinical history

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of very rapid growth prior to the amputation, rapid recurrence, and death within a few months, prove that this case, likewise should not be classed in the benign giant-cell group. Case No 7 clinically, and from the X-ray pictures, closely resembled a benign giant-cell tumor, the microscopical diagnosis in this case was giant-cell sarcoma (Doctor Jeffries), but the slides were lost in moving from the old Polyclinic Hospital to the present hospital, so that I have not been able to get other opinions on the histological structure of the tumor. In this case, the patient had prolonged toxins after amputation, which may or may not have had anything to do with the fact that she remained well for three years before metastases developed. In case No 5, the tumor had been pronounced a giant-cell sarcoma by a most competent pathologist at the time of the operation, but Doctor Ewing, on reviewing the slide after the death of the patient, stated that it was not of the benign giant-cell type. In the other cases, I have not been able to obtain any slides of the tumors. But the fact remains and an important fact that, at the time of the operation, the diagnosis of giant-cell sarcoma was made by competent pathologists in all of the 7 cases in which metastases later developed. In one case only, case No 6, did the pathologist state that there were present two different types of giant cells, the benign and malignant, making the prognosis doubtful.

From the point of view of furnishing important aid to the surgeon in enabling him to determine the best method of treating these cases, it is the primary diagnosis of the pathologist, made at the time of the operation, and not the one made after the end-results are known, that is of account.

Locality in Personal Series of Long-bone Cases—Femur, 22 cases, tibia, 13 cases, humerus, 6 cases, fibula, 2 cases, radius, 7 cases, ulna, 1 case. Total, 51 cases. In addition, we have observed 10 cases of giant-cell sarcoma of other bones. Jaw, 3 cases, spine, 3 cases, sacrum, 1 case, ilium, 2 cases, sternum, 1 case. Total, 10 cases.

In 19 of 22 femur cases, the disease occurred in the lower third and in 3 cases in the upper third, in 13 tibia cases, the upper third was the seat of the disease in 12 cases, in 6 humerus cases, the disease occurred in the upper third in 5, and in the shaft in 1 case.

Age ‡—Five to 10 years, 4 patients, 10 to 15 years, 5 patients, 15 to 20 years,

‡ While Bloodgood believes that giant-cell sarcoma rarely occurs under the age of fifteen years, our present series shows nine patients less than fifteen years of age, and four patients less than ten years.



FIG 28—(Case No 15 in text) Giant- and spindle-cell sarcoma of upper end of tibia, complete destruction of 5 inches of bone. Treated by curettage, toxins and radium. Picture shows condition five years later, replacement of new bone.

8 patients, 20 to 30 years, 17 patients, 30 to 40 years, 6 patients, 40 to 50 years, 5 patients, 50 to 60 years, 4 patients over 60 years, 1 patient, total, 50 patients

Duration of Disease—Less than 6 months in 25 cases, from 6 months to 1 year in 9 cases, from 1 year and over in 6 cases, not known in the remainder

Trauma—In 28 or 56 per cent of the cases there was a history of antecedent trauma, in 15 cases there was no trauma, and in 7 cases it was not stated

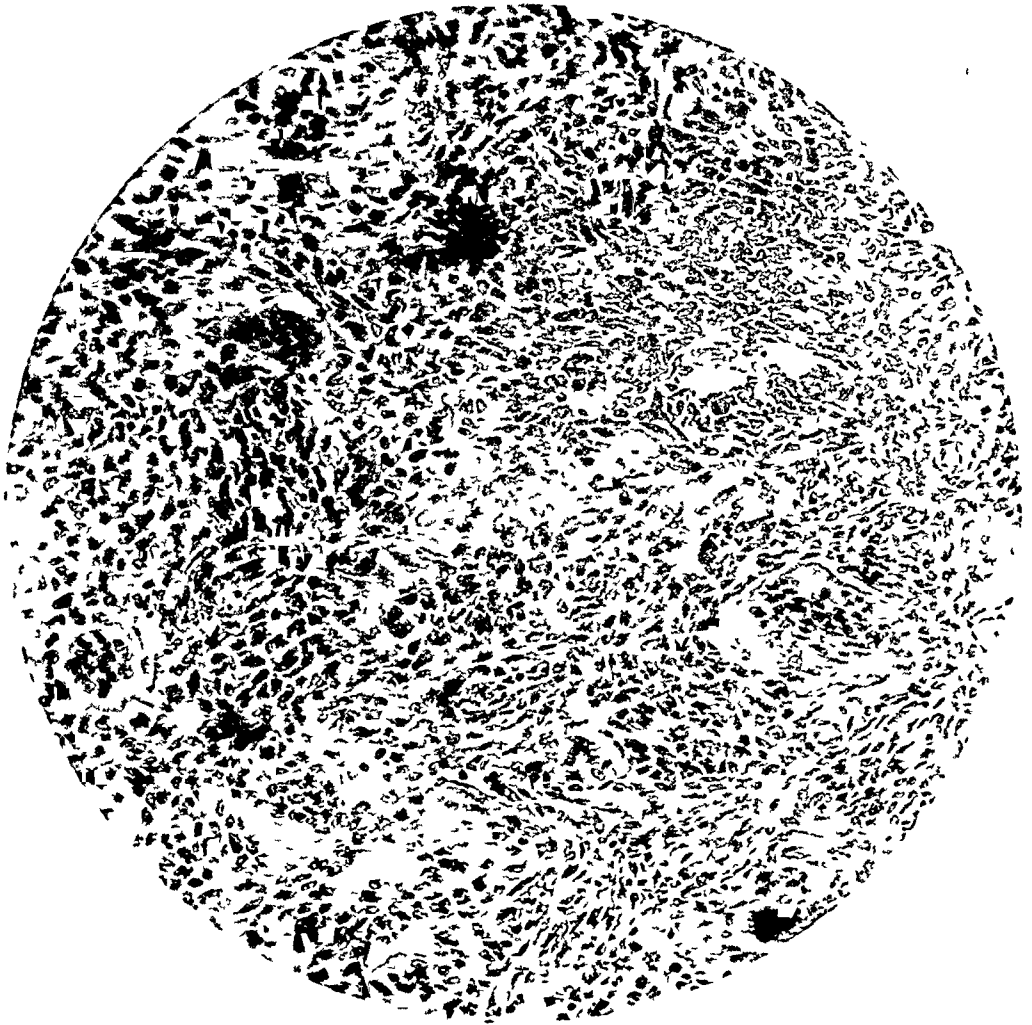


FIG 29 —(Case No 15 in text)

As to the nature of the trauma in 5 cases there was a sprain, in 6 cases a recent fracture, in 5 cases a blow and in 12 cases a fall

Sex	Male	23 cases
	Female	27 cases

Microscopical Examination A microscopical diagnosis of "giant-cell sarcoma" was made in 38 cases, of "giant- and spindle-cell sarcoma" in 5 cases, of "microscopically spindle but from clinical X-ray examination a typical giant-cell sarcoma" in 1 case. There was no microscopical examination made in 6 cases. In 23 of the 44 cases, the microscopical examination

PROGNOSIS IN GIANT-CELL SARCOMA

was made by Doctor Ewing. In many cases, the diagnosis was confirmed by several pathologists.

Method of Treatment in Living Cases

Toxins alone	3 cases
Toxins and curettage	5 cases
Toxins, radium, curettage	6 cases
Radium and curettage	4 cases
Toxins and amputation	2 cases
Radium and X-ray	7 cases
Curettage alone	2 cases
Amputation alone	1 case
Resection alone	1 case
X-ray and amputation	1 case
—	
	32 living cases

Of the entire series of 50 cases, 32 patients are alive, 10 have died (9 of metastases, 1 of nephritis a year and one-half after amputation), 1 patient was in a hopeless condition from metastases when last seen and will probably die, and 7 patients have not been traced. In 24 cases the limb was saved.

End-results

22 femur	17 are living and 8 well, 3 to 20 years later, 5 died (4 with metastases), (1 nephritis, 1½ years after amputation)
13 tibia	7 are living and 5 well, 4 to 17 years later, 3 died of metastases, 3 not traced
6 humerus	2 are living and well, 2 to 4 years later, 3 died of the disease, 1 recent case getting worse
2 fibula	2 cases traced for only a short period
7 radius	6 are living and well, 3 to 15 years later, 1 recent case
1 ulna	1 case seen in consultation, later resected by Doctor Bloodgood, well 10 years
5 jaw	1 well 8 years, then died of other trouble, 1 died of rapid increase of local disease without definite metastases, no autopsy, 1 not traced
2 spine	1 living and well, 21 years later, 1 living and well, 2 years later (patient still alive but paralyzed)
1 sacrum	1 case, disease held in check with toxins and radium for 3 years, but not cured
1 ilium	1 case treated by repeated operations with rapid recurrences, radium tried without success, toxins for a long period, with breaking down of tumor, curettage, patient well 5 years, then died of probable nephritis
1 sternum	1 case, inoperable, with extensive metastases in glands of neck, toxin treatment with marked improvement and apparent control, later died of nephritis

TO BE CONTINUED

ADAMANTINE EPITHELIOMA OF THE LOWER JAW*

CLINICAL REPORT OF TWO UNUSUAL CASES

By J. SHELTON HORSLEY, M.D.

OF RICHMOND, VA.

IN order to comprehend the etiology and structure of the intrinsic tumors of the jaw whose origin is connected with the development of the teeth, it is necessary to review the embryology and the histology of the teeth. There is

a rather striking resemblance between the origin of the hair and the teeth. Scudder has called attention to this analogy (Scudder, C. L., *Tumors of the Jaw*, 1912, pp. 163 and 165). In the first stage of specific development of both hair and teeth, the earliest change noticed is that the deep layers of the epidermis form buds and grow into the tissue beneath it, dipping into the mesenchyma of the alveolar processes. At the same time, a papilla arises from the mesenchyma which grows up into the epithelial cord.

One of the early stages in the embryology of the teeth is represented by Fig. 1. In a 40-mm embryo about the beginning of the third month, a shelf of epithelial tissue, a development of the original bud or cord from the under surface of the epidermis, pushes down. This is called

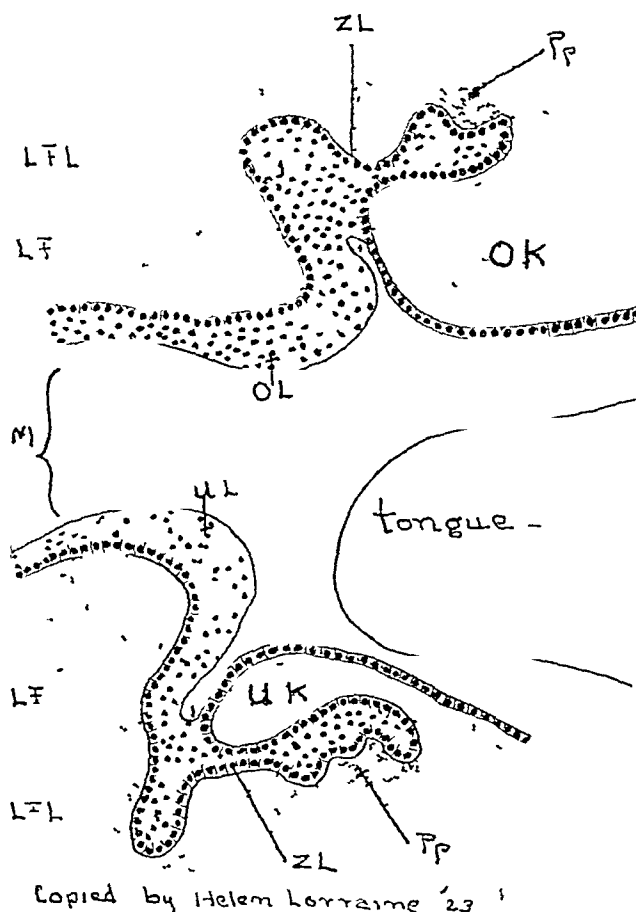


FIG. 1.—Dental anlagen from a human fetus 40 mm long (Jordan Fig. 312). LF, dental groove; M, oral cavity; OK, mesoblast of upper jaw; UK, anlagen of lower jaw; OL, epithelium of primitive upper lip; and UL, of the lower lip; ZL, dental lamina; LFL, labial lamina; Pp, dental papilla. (X 60) (After C. Rose.)

the dental lamina. During the third month of foetal life the anlagen of all the temporary teeth are laid down. About the same time a thin portion of this dental lamina buds out and forms the anlagen of the permanent teeth. A papilla from the mesenchyma pushes up into the cord of epithelium as shown

* Read before the Southern Surgical Association, December 11, 1923.

ADAMANTINE EPITHELIOMA OF THE LOWER JAW

in Fig 2 This epithelial cord is converted into an isolated closed sac, the enamel organ, by the development of a membrane, the dental sac, which severs the epithelial bud from its original stalk and at the same time surrounds the papilla from below The primitive tooth thus lies within the dental sac which develops about the end of the third month (Fig 3)

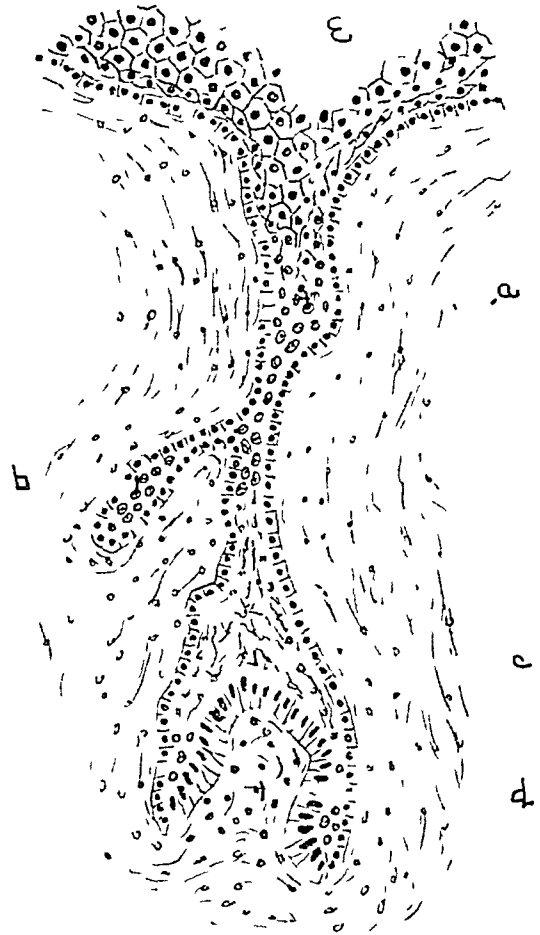
The enamel organ sits upon the papilla as a cap and the papilla pushes into this closed sac Within this sac is a rather soft material called the enamel pulp In the earlier stages the sac of the enamel organ reaches almost to the base of the papilla

From the papilla is developed the dentine, which is the hard ivory substance of the tooth, and upon the dentine in that portion of the tooth which is above the gum rests the enamel, consisting of very hard prisms These arise from the layer of the enamel organ in contact with the papilla, and are formed by the cylindrical cells nearest the papilla called ameloblasts, into which calcium salts, chiefly calcium phosphate, are deposited, making a substance of extreme hardness The outer layer of the root of the tooth, or the cementum, is developed from mesenchyma and is formed by ossification of that portion of the wall of the dental sac which covers the base of the dental papilla and the root of the tooth The cementum has no epithelial connection

The dentine, on which the enamel and the cementum rest, is developed from cells called odontoblasts, and is penetrated by an abundant system of canals containing branches from the odontoblasts and nerves

The enamel pulp consists of soft material within the enamel sac and at first seems to resemble syncytial tissue As the tooth develops, the cells take form and become stellate with long anastomosing processes No blood-vessels penetrate the enamel organ, though blood-vessels, nerves and lymphatics communicate freely with the papilla through the dental foramen below (Fig 4)

The outer layer of the enamel organ which lies on the interior of the



Redrawn by
Helen Lorraine 23

FIG 2—Vertical section of cusp of human fetus, showing the budding of the primitive epithelial cord (X 70) (Marshall's "Operative Dentistry") (Scudder, Fig 152) A, primitive epithelial cord, B budding of the primitive epithelial cord, C, enamel organ, D, dentin papilla, E, epithelial cells

dental sac except at the base of the tooth forms several layers of flattened epithelium. According to Jordan (Jordan, H. E., Text-book on Histology, 2nd edition, 1920, page 335), "Remnants of this cell layer frequently persist in relation to the inner margin of the bony alveolus." The bony alveolus is formed by ossification of the connective tissue around the embryonal dental sac. Such remnants of epithelial tissue can give origin to the epithelial tumors which are found in connection with the teeth. The dental root cyst may arise from portions of this epithelium attached to the root of the tooth and carried down into the jaw by the development of the root. The dentigerous

cyst comes from the abnormal development of the dental sac.

One of the most interesting tumors of the jaw is the adamantinoma, or adamantinoma epithelioma, to which the excellent work of Bloodgood has called attention. This tumor, while unusual, is not rare. In its development, columnar cells are conspicuous. These are supposed to be analogous to the ameloblasts of the enamel organ and often form what

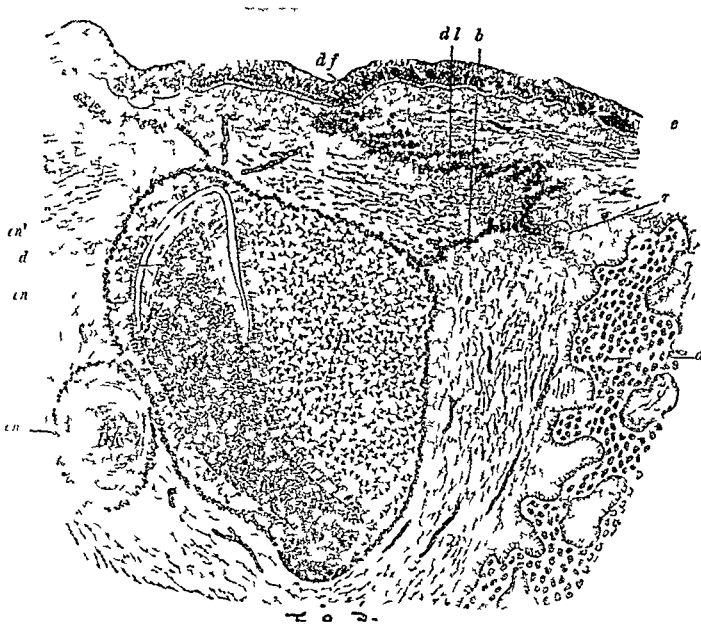


FIG 3.—Section of first milk incisor of a human embryo 30 cm long. Frontal section through lower jaw (X 30) (Rose) (Schaffer Fig 739). DK tooth pulp, d odontoblasts, a bone of alveolar process of jaw, en en inner and outer layers of enamel organ, SP enamel pulp, df dental furrow, e mouth epithelium, dl remains of dental lamina, b cell bridge connecting this with tooth germ, r reserve germ for permanent tooth, en germ of 2nd milk incisor cut obliquely.

resemble tubules or acini, containing, however, a structure like the enamel pulp with poorly differentiated star-shaped cells, or, in some instances, apparently squamous epithelial cells. Not infrequently this material forms a cyst which may enlarge, probably by coalescence with adjoining cysts, and make a cavity of considerable size. Some authors, as Broders, A. C., and MacCarty, W. C. (Epithelioma, Surgery, Gynecology and Obstetrics, vol xxvii, August, 1918, pp 141-151), and Buchtemann and Kolaczek, think that the adamantinoma develops directly from the epithelium of the gum and not from the enamel organ. The accompanying two photomicrographs, kindly given by A. C. Broders (Figs 8 and 9), are very suggestive of such an origin. The columnar cells that are found in adamantinoma resemble somewhat the basal cells of the epidermis of the gum.

According to Broders and MacCarty, the stellate cells, which are supposed to correspond to the enamel pulp, may resemble the prickle cells of the

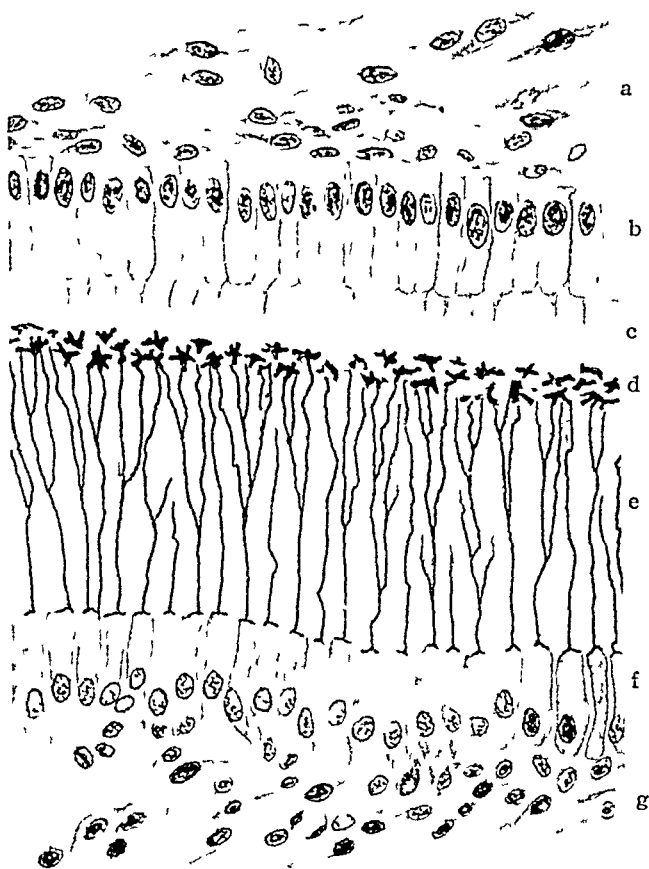
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epidermis Then, too, they assert that cysts similar to those usually found in adamantinomas are also seen in squamous-cell cancers as a result of the degeneration of cells As the enamel organ arises from the under surface of the epidermis of the gum, it is quite possible that the adamantinoma may come directly from this tissue There are many basal cell cancers in which this same type of columnar epithelium of an adamantinoma, corresponding to the basic or germinal layer, is found (Figs 10 and 11) The clinical course of adamantinoma, however, is quite different from that of basal-cell cancer

Of the two cases reported here, the first seems a direct descendant of remnants of the enamel organ In the other, which contains what appears to be epithelial tissue, the origin is more obscure

CASE I—Mrs J E W, aged twenty-nine, referred by Dr B F Royal, of Morehead City, N C, entered St Elizabeth's Hospital on January 16, 1919 She had ptosis of the stomach and transverse colon, cholecystitis, and a cyst in the right lower jaw This was thought to be a dentigerous cyst The cyst was first noticed in 1917, though there had been pain in the lower jaw for the past eleven years The pain was frequently rather severe About nine months ago some operation was done by another surgeon, and a few months later operation was performed upon the cyst The technique of these operations could not be determined, but it was doubtless an incision from within the mouth No permanent relief was obtained On

January 17, 1919, I operated, plicating the gastrohepatic and gastrocolic omentum and removing the gall-bladder, which was very adherent After completing the abdominal operation, a transverse incision, on a level with the lower portion of the ear, was made over the cyst in the jaw The cyst seemed to be about two inches in diameter It appeared bluish in color, and there was no bone covering this portion of its exposed wall The cyst was incised, and more than an ounce of slightly muddy fluid was evacuated The cyst wall was removed as far as possible by curetting The cavity was filled with the Moorhof iodoform plug, and the wound was closed in layers with tanned catgut Convalescence was satisfactory except that some of the Moorhof plug worked through the incision and the scar was very prominent On February 12, 1919, the scar was excised under local anæsthesia,



Adapted by Helen Lorraine '23

FIG 4—Section of developing tooth through junction of enamel and dentine (X 400) (Modified from Piersol) a, intermediate layer of enamel organ, b, ameloblasts, c, young enamel with Tomes processes, d granular layer Tomes, e, dentine, f, odontoblasts, g, embryonal pulp-tissue

and the wound united with a subcuticular stitch of silkworm gut, over which was placed an epidermal suture of fine silk. She was discharged February 17, 1919.

The patient returned on May 31, 1923. The growth on the jaw had increased in size. After leaving the hospital in February, 1919, she felt well for several months, then pain of a dull aching character began in the left lower jaw, and occasionally extended down her neck and to the back part of her head. During the last six months there has been a marked increase in the size of the growth

in the lower jaw, which for a time after the operation was hardly observable. The pain has also increased.

On inspection there was a large growth in the right lower jaw. Rontgenographic report by Dr. Fred Hodges follows: "There is an extensive cystic involvement of the bone extending from the first bicuspid tooth back beyond the angle of the jaw on the inferior border, and on the superior border, practically back to the con-



FIG. 5.—Drawing of specimen removed from Case I, external view. On the right is a small margin of healthy bone with the alveolar process containing three teeth. On the left the tumor has been exposed during removal of the growth and below attached enlarged lymph nodes which on section were merely hyperplastic.

dyle of the jaw. The jawbone is practically entirely destroyed, and there are a good many bony septa dividing this area into many different parts.

On June 1, 1923, the patient was operated upon under gas-ether. An incision was made from about the middle of the right mastoid process downward, forward and inward, along the border of the lower jaw to the middle of the neck. The tissues were dissected down, and the facial vessels were doubly clamped and divided. The whole mass of tissue was dissected up, taking care to keep close to the jawbone. The wall of the tumor was exceedingly thin, and at one point anteriorly was opened. A small amount of thick, clear, yellowish fluid containing some flocculent particles was evacuated. This was washed off with sterile water. The dissection was carried beneath the jaw, and the attachment of the muscles to the right half of the jaw was severed. Anteriorly there were a few enlarged lymph-nodes, and these were left attached to the tumor. The incision was carried through the lower lip and the bone was divided anteriorly, about one-half inch in front of the diseased tissue. The growth was then retracted outward, and the dissection was made internally, preserving as much mucosa as possible and packing the mouth with gauze to prevent aspiration of blood. The bone was severed posteriorly with bone forceps. The growth involved the anterior portion of the ramus of the jaw. A small fragment was left at the upper part, and this was removed separately. The raw surface at the stump of the bone was cauterized with

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the electric cautery. The mucosa of the mouth was sutured with a continuous suture of tanned catgut. The skin wound was closed with a continuous suture of silkworm gut, leaving a drainage tube through the posterior end of the wound. No effort was made to fill in the defect left by removing the jaw, as the mouth cavity had been widely opened and it was felt that a graft would not take at this time. The operation lasted one hour and twenty minutes.

The specimen consists of the tumor from the lower jaw, together with one lymph-node which is enlarged and soft. The tumor is three and one-half inches long, by two inches wide. On the upper surface is the alveolar process with three lower teeth anteriorly. They seemed quite firmly imbedded in the gum. Externally most of the growth consists of a bulging out and thinning of the bone until at most places the bone is

merely the thickness of parchment and over some areas has disappeared. Both anteriorly and posteriorly there is about one-half inch of healthy jawbone, except at the upper portion posteriorly, where the section was made partly through diseased tissue and the small remaining fragment of diseased tissue removed with bone forceps (Fig 5).



FIG 6—Drawing of specimen shown in Fig 5. An incision has been made along the outer wall. Note the thin capsule of the growth, and in the right side a cyst containing smooth walls with imperfect partitions. Through about the centre of the specimen is a complete partition, and on the left is soft content. To the left of the central partition the material is a dark purplish color. In other portions the solid material is yellowish.

Longitudinal incision with a knife shows in the lower half of the specimen several cavities whose walls are lined with a thin membrane, beneath which is a very thin layer of bone. The bone can be readily dented with the finger. There is a small bridge of bone along the alveolar process containing the teeth. Just in front of what corresponds to the angle of the lower jaw and internally the wall of the tumor is very thin. The cysts communicate and there are incomplete partitions between them. The wall is smooth. In the upper posterior portion of the specimen, there is a solid mass of tissue which fills a compartment. This is rather soft and most of it is a pale yellow, though anteriorly and below the tissue is purplish in color. All of the tissue can be easily separated from what appears to be the capsule, which resembles very much the wall of the cysts that contained fluid (Fig 6). The lymph-node on section is oblong, about an inch in diameter, and soft. It seems to be hyperplastic. Microscopic sections in celloidin show typical structure of adamantine epithelioma, or adamantinoma. The columnar cells are abundant, and are arranged somewhat irregularly as tubules or as acini. In portions of the growth there is a myxomatous-like material with stellate cells resembling enamel pulp (Fig 7). The patient made a satisfactory recovery from the operation, and left the hospital on June 20, 1923.

Under date of December 6, 1923, in a letter from Doctor Royal, the patient's family physician, he says that soon after returning home the patient had a small

sinus in the chin, which led down to the bone. He dilated and curetted this sinus, and it promptly healed. He has not seen her very recently. He says the deformity is inconspicuous, being only a slight flattening, and the scar is hardly visible as it lies largely in the fold of the neck.

Under date of December 8, 1923, the patient writes me that so far as she can tell there is no recurrence, but that the jaw pains her some, and "swells when I eat or worry." The swelling may be due to the action of the parotid gland.

CASE II—This patient, Mrs. A. R. T., aged forty-one, referred by Dr. J. Bolling Jones, of Petersburg, Va., entered St. Elizabeth's Hospital, on May 19, 1918. The family history was of no significance. She first noticed some swelling

under her tongue on the right side of the mouth about twenty years ago. This, however, did not trouble her until the last few years when it enlarged and the jawbone apparently was affected. She had been operated upon about two years before this by another surgeon, who had removed a portion of the alveolar process from the lower right jaw.

There was a recurrence of the growth. It involved the lower jaw on the right side, extending from a short distance



FIG. 7.—Photomicrograph of the tumor shown in Figs. 5 and 6. The columnar cells of which this growth is largely composed are arranged somewhat irregularly as tubules or acini. In the lower right corner is part of a mass of tissue resembling somewhat enamel pulp. Areas of this kind are common in the section and often are of large proportions. (X 150.)

from the symphysis back to near the angle of the jaw. It was rather sharply circumscribed, though it apparently infiltrated the immediate tissue along the adjacent portion of the floor of the mouth.

An incision was made along the lower border of the right side of the jaw, extending up over the chin in the midline. The bone near the midline was divided with a wire saw. The growth was dissected out with the electric cautery, taking care to include the adjoining adherent tissue. The jaw was sawed posteriorly at the angle. A graft was taken from the tibia. The ends of the graft and the stumps of the bone of the jaw were drilled and the graft was fastened in position with kangaroo tendon. An effort was made to suture the mucosa of the mouth over the graft. There was some tension in the suturing, and the mucosa could not be satisfactorily approximated. The wound was closed and a small drain of catgut was inserted at the posterior angle.

The specimen consists of the right side of the lower jaw extending from near the symphysis to a point just anterior to the angle of the jaw. The specimen

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measures two and one-half inches in length. At the two extremities there appears to be healthy normal bone. Between these there is a tumor which bulges the bone in all directions. On the internal surface of the tumor a small amount of soft tissue is adherent. This presents a charred appearance resulting from the dissection with the electric cautery. There is a very thin capsule of bone around most of the growth. At other points the bone seems to be entirely missing, and is replaced by a fibrous capsule. Where the bone is present it is exceedingly thin and can be easily dented with the finger (Fig 12). On section the tumor seems to be solid without any cystic formation. The jawbone has been expanded and absorbed, so that the thin capsule can be readily cut with a knife. The tumor has a yellowish appearance with occasional red specks. It is moderately firm, but elastic. It is not encapsulated, though it is distinctly circumscribed. It appears



FIG 8—Photomicrograph of adamantinoma showing apparent origin of growth from the epithelium of the gum (X 50) (From A. C. Broders)

to displace the tissue as it grew, though there is some infiltration at certain areas. This, however, is limited (Fig 13). A block is taken for celloidin section (Fig 14).

Infection followed, and the graft had to be removed. The wound gradually healed, and the patient left the hospital on June 21, 1918.

On October 1, 1920, she was admitted to the hospital, and a sebaceous cyst of the scalp was removed and a small enlargement on the alveolar process of the left side of the jaw was removed with a curette and the tissues were thoroughly cauterized. There was no evidence of any growth on the right side. Microscopic examination did not show this tissue to be a recurrence.

On September 23, 1921, she was admitted with a small recurrence, and operated upon. The anterior part of the incision in the neck which was made in the first operation was incised and the end of the jawbone was exposed. A small portion was cut away with bone forceps. The bone appeared to be normal. There was a nodule in the floor of the mouth on the right side about an inch from the bone. This was dissected out without opening the mucosa and the tissue was examined with frozen sections. The nodule was firm and about one-quarter inch in diameter. A frozen section showed malignancy. The tissues around the nodule were thoroughly cauterized with electric cautery without penetrating to

the mouth. The wound was closed with silkworm gut, leaving a rubber tube for drainage. A small nodule on the exterior surface of the bone about two inches from the midline was exposed and curetted. There appeared to be no evidence of malignancy. This wound was thoroughly cauterized with the electric cautery. The operation lasted fifty minutes.

The specimen consists of the small piece of tissue described in the operation. A gross section shows a firm, yellow growth that is not encapsulated. There is a small amount of muscular tissue attached. Microscopic section shows the growth of the same nature as the original. The histologic appearance of the original tumor removed by me was so unusual that I was unable to make a definite diag-



FIG 9—Section from the central portion of the tumor shown in Fig 8 which gives a more characteristic appearance of adamantinoma (X 50) (From A C Broders)

nosis except that it was malignant. Sections or blocks of tissue were submitted to several prominent pathologists.

Dr J C Bloodgood, under date of August 2, 1919, said: "This section shows tubular alveoli of cells whose nuclei take the hæmatoxylin stain, imbedded in a very fibrous stroma. These alveoli are not all tubular, some are irregular masses and the question is what these cells are. They do not resemble adamantine epithelium. They show more pearly body formation. Many of the cells are vacuolated. They do not appear to be a type of sarcoma. I am inclined to think that the diagnosis rests between a carcinoma arising in the gum, or one of the rare forms of adamantine epithelioma, in which the peculiar degeneration is not well marked. I shall diagnose it *jaw adamantine epithelioma* until I hear more definitely from Doctor Horsley."

Dr A C Broders, of the Mayo Clinic, under date of July 15, 1918, says: "From the tissue that you sent from Mrs T some time ago, I have made a number of slides, staining some with hæmatoxylin and eosin and also some for fat. Those stained for fat showed the tumor cells to be free from it. It is extremely difficult to say whether this is a sarcoma or carcinoma. At any rate, it is a malignant tumor, though apparently of a low grade." Later, after another study of

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FIG 10.—Basal cell carcinoma from the skin over the eyebrow showing columnar epithelium similar to that found in adamantinoma though the cells surrounded by the columnar epithelium are of a different type from the enamel pulp (X 150)

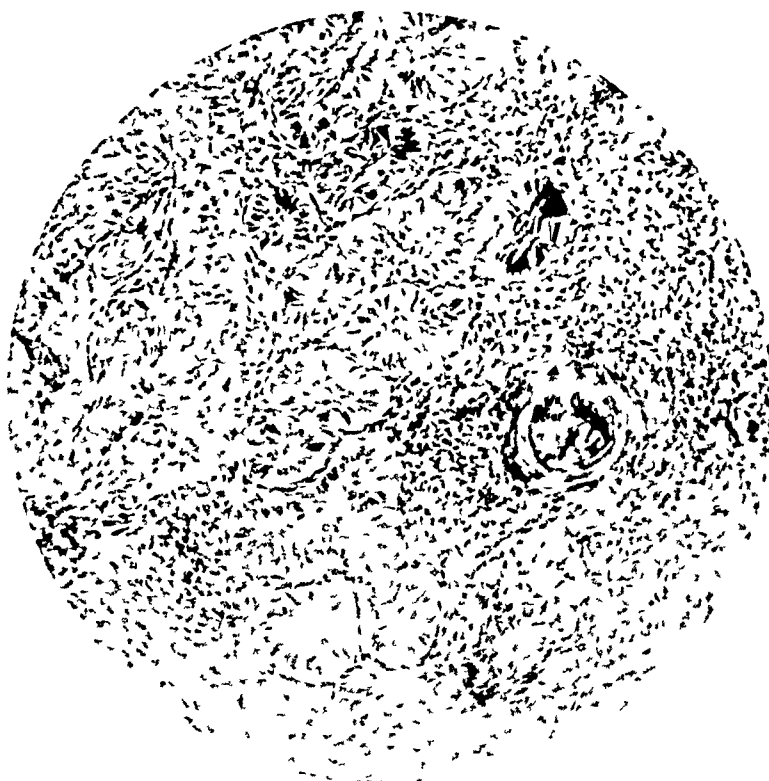


FIG 11.—Photomicrograph of small growth removed from the skin near the inner canthus of the eye. It shows in the upper portion of the photograph spinous cell type of cancer with a "pearl". In the central portion it is a basal cell type, with columnar cells resembling those found in adamantinoma (X 150)

this tissue in August, 1923, he said the tissue showed "epithelioma belonging to the squamous-cell family of adamantine type, of low-grade malignancy," and

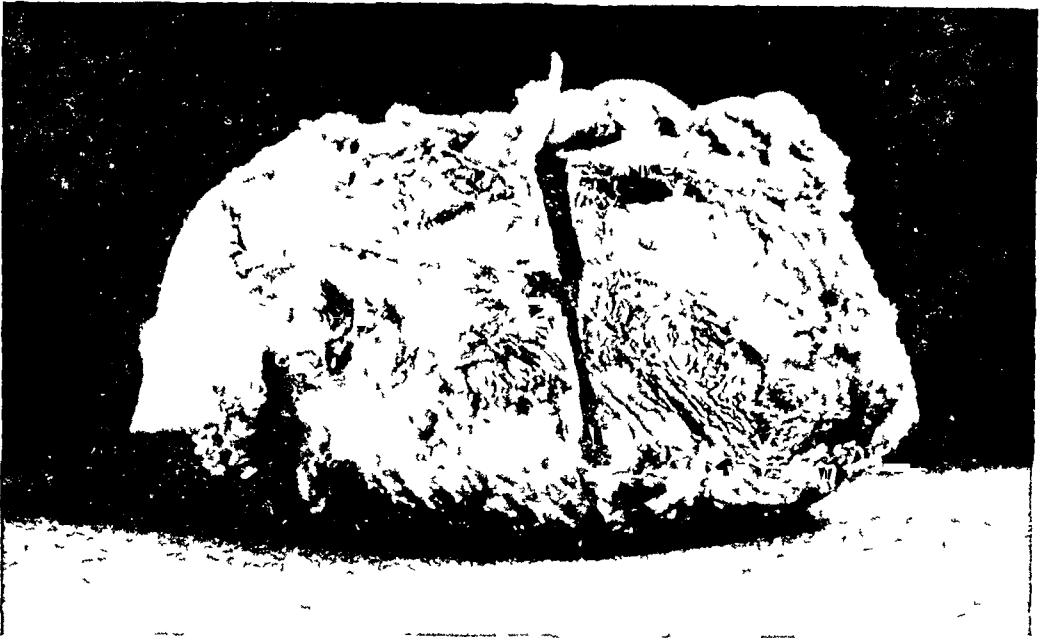


FIG 12 —Photograph of specimen removed from Case II At both ends there was apparently healthy bone

that a section removed from the last operation showed a recurrence of the original growth

Dr Alfred Stengel, of Philadelphia, was interested in the growth and was good enough to go over the sections His report, under date of December 11, 1921,

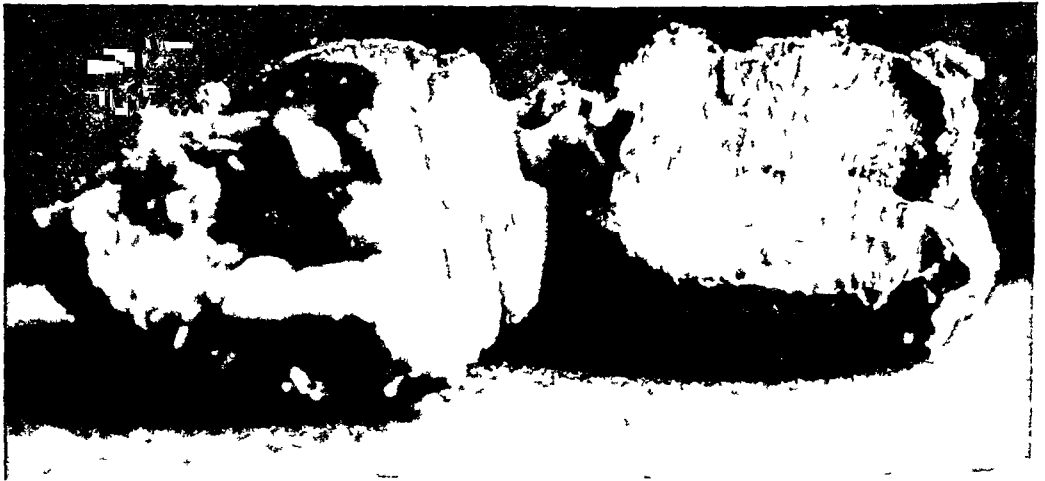


FIG 13 —Photograph of a section of the tumor shown in Fig 12 The capsule is thin The bone in some areas has entirely disappeared The growth infiltrates as well as expands the surrounding tissue

is as follows "The microscopic slide of the very interesting tumor regarding which we spoke at Lynchburg reached me in good time and I have been examining it with several of my colleagues here who were as much interested as I Dr Herbert Fox and I first looked it over and concluded that it was not an adamantinoma, but

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we could not quite agree what we did think it. Both of us were impressed with the curious resemblance of the cell groups to those of certain hypernephromata. I was rather of the opinion that the cells have an epithelial appearance, the stroma being, of course, a very curious feature as well. Doctor Fox, I think, was rather inclined to believe it a dental tumor of some sort, though he did not express nor was he willing to express a positive opinion. We then submitted it to Dr Hopewell Smith, the histologist of the Dental School, and Doctor Ivy of the Dental School, both of whom examined it carefully and stated that they did not believe it a dental tumor of any sort.

Neither of them, however, was willing to commit himself to a positive opinion as to what the nature of the growth might be. All of us, of course, agreed that it was a form of malignant tumor. I confess that I have never seen anything like it and am no more able to reach a conclusion than were the others. The epithelial or endothelial character of the large cell nests impressed me, but I hesitate to say what I would call the thing if I were pinned down to an expression of a positive opinion.

I believe that Dr Joseph McFarland also looked at it, but did not come to any conclusion regarding its nature."

The exact nature of the growth seems difficult to determine. Most of the pathologists feel that it is an epithelial growth, probably of adamantine origin, though an endothelial origin can not be entirely discarded.

Under date of December 6, 1923, Dr J Bolling Jones, of Petersburg, reports that he has examined Mrs T and finds the condition satisfactory, except for "A distinctly enlarged gland the size of a cherry at the posterior inferior angle of the scar on the neck. It is unattached to the skin or scar, and is freely movable and apparently has very little deep attachment. It is in very close proximity to the common carotid, yet apparently not attached to it." Doctor Jones says that according to the patient's statement this lymph-node has been present for eighteen months, and she does not think it has changed in size. In his opinion it would be impossible to say whether this is a recurrence without a microscopic examination.

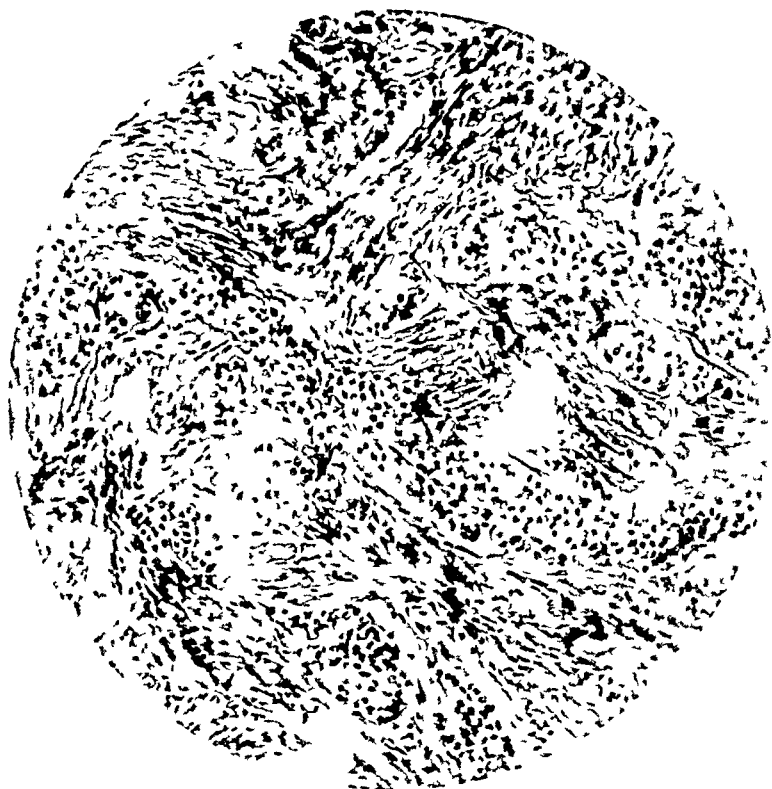


FIG 14 —Photomicrograph of tumor shown in the preceding figures. The portion from which the block was removed is shown in the photograph. The cells seem fairly well differentiated. The cytoplasm is clear. The cells are arranged irregularly in columns or are grouped together in masses. The stroma is well organized but delicate connective tissue. The growth is evidently malignant though of a grade of malignancy. Most of the pathologists are inclined to think it springs from the tooth ramus. (X 140)

THE MATAS OPERATION FOR ANEURISM[†]

REPORT OF PERSONAL CASES

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IN a previous paper [†] I reviewed seven cases of this kind Two additional cases have followed, which I have thought of sufficient interest to report, with a tabulation and summary of the total of nine cases

CASE VIII—E J, male, mulatto, aged thirty years, porter Admitted to Charity Hospital, New Orleans, December 2, 1922, discharged February 26, 1923 This man complained of a swelling in the back of the right knee Previous history negative except for venereal sore twelve years ago, Wassermann test positive For the past six months he has been conscious of a small throbbing tumor in the right popliteal region with pain radiating down the back of the leg to the ankle On examination of the region complained of, inspection and palpation showed an expansile tumor about three inches by two inches, auscultation revealed a soft systolic blow A characteristic sign of aneurism—absence of pulsation in the dorsalis pedis and posterior tibial arteries—was observed The Matas test of collateral circulation showed return of color in from four to five minutes In preparation for operation neoarsphenamin and potassium iodid were given To improve the circulation the Massachusetts General compressor was applied daily for 10 to 45 minutes, the electric bath was applied and digitalis administered

Operation was done January 15, 1923, Dr Rudolph Matas acting as consultant Spinal anæsthesia was employed, two grains of apothemin being injected between the eleventh and twelfth thoracic vertebræ After application of the Esmarch bandage and constrictor the sac was exposed and incised in the mid-line About one and one-half ounces of firm, mixed clot were removed The afferent opening was readily exposed on the floor of the sac about one inch from the upper pole, the efferent was found at the extreme lower pole Both were closed with a double row of continuous paraffin silk sutures On loosening the constrictor, blood escaped at both openings The loss from the distal end was profuse, showing good collateral circulation Both lines of suture were reënforced On removal of the constrictor the foot assumed a hyperæmic color The cavity was obliterated by plication with catgut sutures Buried catgut sutures for muscles and fascia were used The skin was closed with interrupted sutures of silkworm gut and linen After the usual aseptic dressing the limb was wrapped in cotton wadding and encased in a regular aneurism mattress pad (Matas) Aseptic healing followed The convalescence was uneventful except for pain resulting from the spinal puncture Observation of the case continued for several months after discharge, during which there were no new developments

CASE IX—L C, colored, male, aged thirty-eight years, laborer Admitted to Charity Hospital, September 3, 1923, discharged November 20, 1923 His complaint on admission was swelling of left thigh, weakness of left knee and hip-joints Previous history Alcoholic indulgence, chancre denied Wassermann test was negative Two and a half months ago he was stabbed in the thigh with a pocket knife There was profuse bleeding at the time For a week he was unable

* Read before the Southern Surgical Association, December 11, 1923

† New Orleans Medical and Surgical Journal, vol LVII, pp 598-607

THE MATAS OPERATION FOR ANEURISM

to use the leg, which was quite swollen, though not as large as it was later. About four weeks after the injury while the patient was walking, the limb began to swell and assumed the proportions seen at the time of admission.

Examination showed a smooth, rounded swelling in the second fourth of the thigh from the groin, encroaching on the third fourth, it extended transversely so as to cover the ventral and mesial surfaces, eight inches in long diameter, 10 inches in transverse. Inspection showed pulsation straight up and down, none in a transverse direction. Palpation revealed thrill beginning centrally to the mass and extending along the line of the femoral vessels to a point distal to the mass. Elsewhere over the mass there was arterial pulsation only. There was a systolic bruit all over the mass, superimposed on a steady hum which was heard best over the vessel line, where thrill was palpated, this hum was especially marked opposite the knife wound scar, which was at the junction of the ventral and lateral surfaces a little above the middle of the thigh. Central to the mass there was a peculiar systolic bruit, somewhat musical.

On these data a diagnosis of arterial varix was made, the signs being interpreted as showing a direct communication between artery and vein, without any intervening aneurismal sac. As might be expected, pulsation in the dorsalis pedis and posterior tibial arteries was less vigorous than on the opposite side. A curious observation was that of the blood-pressure in this case. There was some difference between the two brachials, the right registering 108-60, the left 92-50. The pressure just above the patella was 120 systolic on the normal side, only 80 on the affected side. This was to be expected on account of the diversion of a part of the arterial blood into the vein. But a strange and inexplicable observation made in this connection was that while the pressure at the groin on the normal side was 140-70, that just above the swelling on the affected side ranged from a systolic reading of 240 mm down to 0, the arterial beat being heard when no pressure was recorded by the manometer. This observation confirmed an independent reading by the interne of the service.

It is a well-known fact that arteriovenous aneurism in some cases exists for a long time without doing any harm. In this case there was not a network of large distended veins associated with signs of bad nutrition, such as we observe at times, but the exposed situation of the lesion, in a man who earned his living by rough work, caused operation to be decided on.

This was done September 18, 1923, under ether anæsthesia. After elevation of the limb, a rubber tube was applied at the groin for hæmostasis. A right-angled flap was marked out through the skin, its base lateral, the extremity median to the line of the vessels. The sartorius was freed and cut across at the lower angle of the wound. Hunter's canal was opened and the femoral artery exposed and traced up to about two inches distal to Poupart's ligament. This was done with some difficulty because the tissues were abnormally adherent. The vein was not seen. At the level mentioned, while tissues were being separated with the handle of the scalpel on the median side of the artery, a venous cavity was opened, which bled freely, despite the rubber tube constriction, and had to be packed. This was the median and smaller portion of the dilated vein, which extended from here posteriorly to the artery and projected on its lateral side. This arrangement had not been recognized in the previous study of the case. The arterial opening, which was in the common femoral artery, just above the bifurcation, was a slit nearly one-fourth of an inch long. This was closed by continuous lateral arteriorrhaphy, using fine silk drawn through sterile vaseline, on a round curved needle. The lumen of the artery was noticeably diminished. The opening in the venous sac was enlarged and the afferent or distal orifice whipped over with silk from within, the central orifice not being identified and not causing any trouble through hemorrhage.

TABLE I

Name	Age	Occupation	Race	Diagnosis	Treatment	Congene	Hemorrhage	Recurrence	Remarks	Reference
1 G D	32	Brick-mason	Mixed	Fusiform aneurism, right popliteal artery, lower two-thirds	Intrasaccular suture (obliterative endoaneurismorrhaphy Matas)					ANNALS OF SURGERY, vol 11, pp 115-117
2 C W	22	Laborer	Negro	Arterial varix of right femoral artery and a vena comes, sequel of gunshot wound	Incision of vein, suture of opening in artery (Modified Matas-Bickham technic) (Restorative)					N O Med and Surg Journal, vol 1x, pp 553-556
3 F L	29	Painter	Negro	Fusiform aneurism, right popliteal artery, middle portion	Intrasaccular suture (obliterative endoaneurismorrhaphy Matas)				No recurrence after four years (1911)	N O Med and Surg Journal, vol 1x, pp 590-592
4 R W	21	Laborer	Negro	Varicose aneurism right profunda artery and vein, sequel of gunshot wound	Intrasaccular suture (obliterative endoaneurismorrhaphy Matas)				Patient died of erysipelas 18 days after operation	N O Med and Surg Journal, vol 1xi, pp 531-533
5 P S	53	Swamper	Mixed	Fusiform aneurism, right iliofemoral region	Intrasaccular suture (obliterative endoaneurismorrhaphy Matas)				Patient died of multilocular prostatic abscess 43 days after operation	N O Med and Surg Journal, vol 1xii, pp 631-633

THE MATAS OPERATION FOR ANEURISM

6	T W	25	Not recorded	Negro	False aneurism, left femoral artery, following gunshot wound	Incision of false aneurism (restorative endo-aneurismorrhaphy Matas)	Permeability of vessel not preserved	Southern Med Journal, vol v, p 306
7	J M	36	Laborer	Negro	Varicose aneurism of right femoro-popliteal vessels, following gunshot wounds	Intrasaccular suture (obliterative endo-aneurismorrhaphy Matas)	Operated on 9 years ago, still well (Jan, '24)	N O Med and Surg Journal, vol lxvii, pp 598-607
8	E J	30	Porter	Mixed	Fusiform aneurism of right popliteal, lower portion	Intrasaccular suture (obliterative endo-aneurismorrhaphy Matas)	Operated on one year ago, still well (Jan, '24)	
9	L C	38	Laborer	Negro	Arterial varix of left common femoral vessels	Lateral suture of artery, intrasaccular suture of venous sac	Permeability of artery preserved	

Sac wall from both median and lateral venous pockets was brought over and sutured around the artery at the level of its sutured opening so as to reënforce this area and make hemorrhage less likely. A silkworm drain was placed in the lateral sac. The sartorius was sutured with No 2 chromic, the skin with linen. The aneurism mattress pad of Matas was placed around the limb. September 20th, two days after the operation, pulsation could be felt in the dorsalis pedis artery. The circulation of the limb appeared entirely satisfactory.

November 5th, the dorsalis pedis pulsation was again recorded as present. It would appear that the lumen of the artery, though lessened by the lateral suture of the knife-slit, remained open. The patient was discharged on November 20th in excellent condition.

As indicated above the lesion was a direct communication between the common femoral artery and vein, the latter spreading out transversely so as to present a smaller median and a larger lateral sac.

Two observations, the explanation of which is not at hand, are the extreme high and low ranges of the blood-pressure above the varix and the absence of hemorrhage from the central end of the dilated common femoral vein. It is also worthy of note that the obliteration of the common femoral vein almost at the groin was followed by no circulatory disturbance. Such a closure, when no opportunity for adjustment has been afforded, is very apt to be followed by moist gangrene. The period which elapsed between the injury and the operation probably permitted collateral circulation to be built up, this being promoted by the increased pressure in the vein.

My personal series of aneurism cases operated on by the intrasaccular method of Matas (including these cases) may be tabulated as follows:

In all there were 9 patients, twenty-two to fifty-three years of age, all of negro descent, 3 mixed, 6 unmixed.

Of the aneurisms 4 were fusiform, 1 false, 4 arteriovenous, of the latter 2 were varicose aneurisms, 2 arterial varices.

Of the 9 cases, four* (the one false and three arteriovenous) were due to gunshot injury, one to stab wound.

Five oblitative operations were done, 4 restorative, and no reconstructive.

No gangrene, no hemorrhage, no recurrence has been observed up to this time.

There was no mortality attributable to the operation, though one died of erysipelas eighteen days after operation, the infection being derived from another case adjacent to the patient in the ward, while a second died of multilocular prostatic abscess forty-three days after operation. A feature of this case was the fact that the diagnosis was not made in life, nor even on post-mortem examination the fatal condition being discovered only when the pelvis was bisected by Professor E. Souchon for the purpose of preserving the specimen of obliterated aneurism.

AN IMPROVED METHOD OF REMOVING HERNIA FROM WITHIN*

BY G PAUL LAROCHE, M D
OF RICHMOND, VA

THE operative story of abdominal hernia is characterized by conspicuous evidence of much thought and effort devoted by surgeons to plastic operative procedures and repair of muscles and fascia in the region of hernia proce-

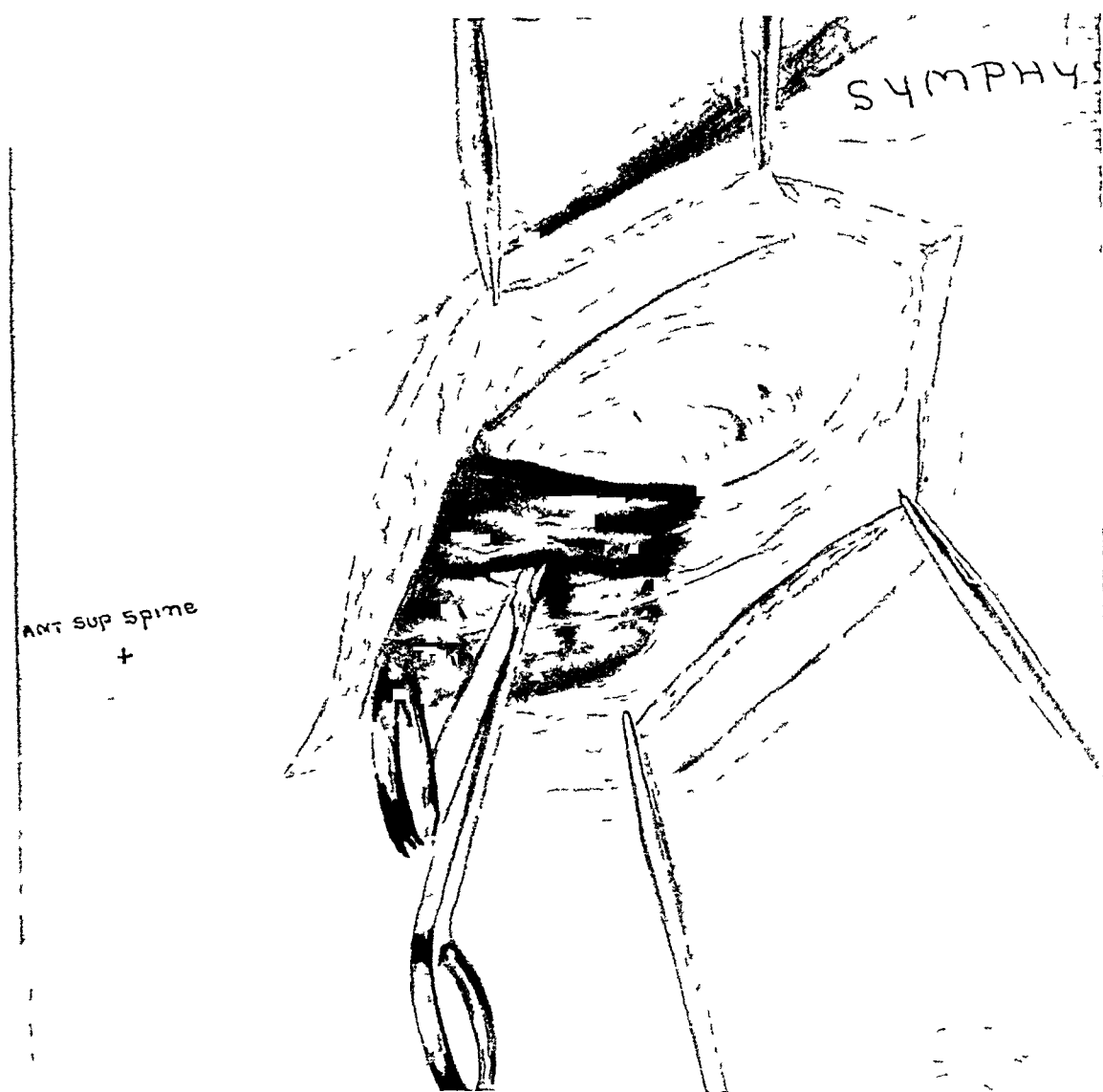


FIG 1 —After dividing the skin, superficial fascia and aponeurosis, the muscle bundles of the internal oblique about an inch above their margin are separated making a good exposure of the peritoneum well above the neck of the sac. The contents of the inguinal canal the rectus sheath conjoint tendon, the internal oblique, nerves and shelving edge of Poupart's ligament are plainly seen.

dures adaptable to the second stage of the operation after the first purpose, removal of the hernia, is completed.

Emphasis upon the necessity of high ligation of the neck of the sac and

* Read before the Southern Surgical Association, December 13, 1923

of discovering combined direct and indirect (pantaloon or saddle bag) inguinal hernia, the utility of inguinal approach to femoral hernia, these are evidences of progress directing attention to the importance of finding and removing all the sac

Ample demonstrations at second operations have shown that failure at the first attempt to cure hernia has been incident quite usually to incomplete removal of all the sac and redundant peritoneum which existed at the time of the first operation, or of unintentional anchorage of the ligated or sutured neck to the tissue into which it was pulled down for excision at the first

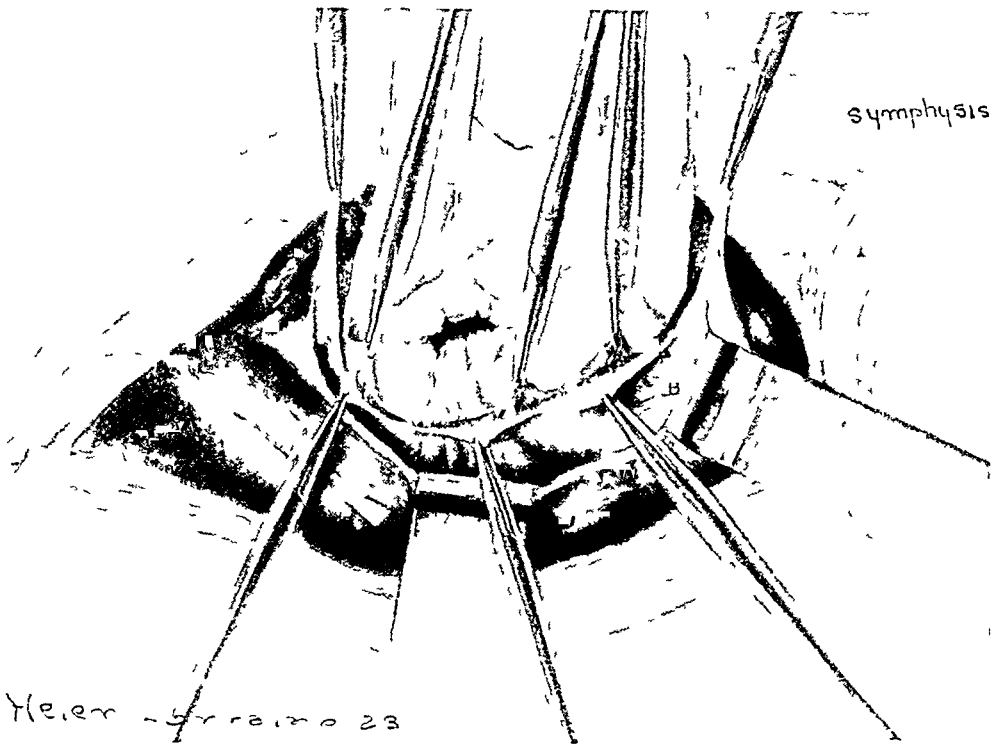


FIG 2 —The peritoneum opened the whole region of hernia exposed and the redundant peritoneum of the area incised and about to be freed over a wide area preliminary to enucleation of the sac Bladder at B vessels and vas deferens plainly seen and felt through peritoneum

operation (We are not considering post-operative incisional rupture, a sequel to suture breakage and wound suppuration)

Permanent cures of herniæ are seen with great frequency after excision and high ligation or suture of the neck of peritoneum followed by less ingenious, if not crude methods of canal repair by less skillful operators. Voices of great respectability¹ within recent years are giving expression to the belief that high removal of the neck of the sac is the most, if not the only essential procedure of the operation for the cure of ordinary indirect inguinal hernia of small or moderate size in children, women and young men though for direct and indirect hernia of large size in individuals with imperfect or absent conjoint tendon, plastic operations and suture of certain fascial structures are useful additional measures. The recent work of Seelig and Chouke² showing the stay of muscle sewed to fascia to be quite temporary, supplies additional

REMOVING HERNIA FROM WITHIN

reason for the belief that much credit for the cure of hernia must be assigned to high removal of the sac

And as we read the story and witness the performance we see little evidence of conspicuous improvement upon the old process of digging in, scrubbing out, pulling down and finally tying off the sac from below and in front, upward and in other directions. This at best is a non-gentle if not crude process and sometimes looks like rough handling, in comparison with gentle, refined, technical procedures of other surgical operations

It is, therefore, quite natural for one to inquire if there may not be room for improvement upon the method of approach to, and excision of, the sac

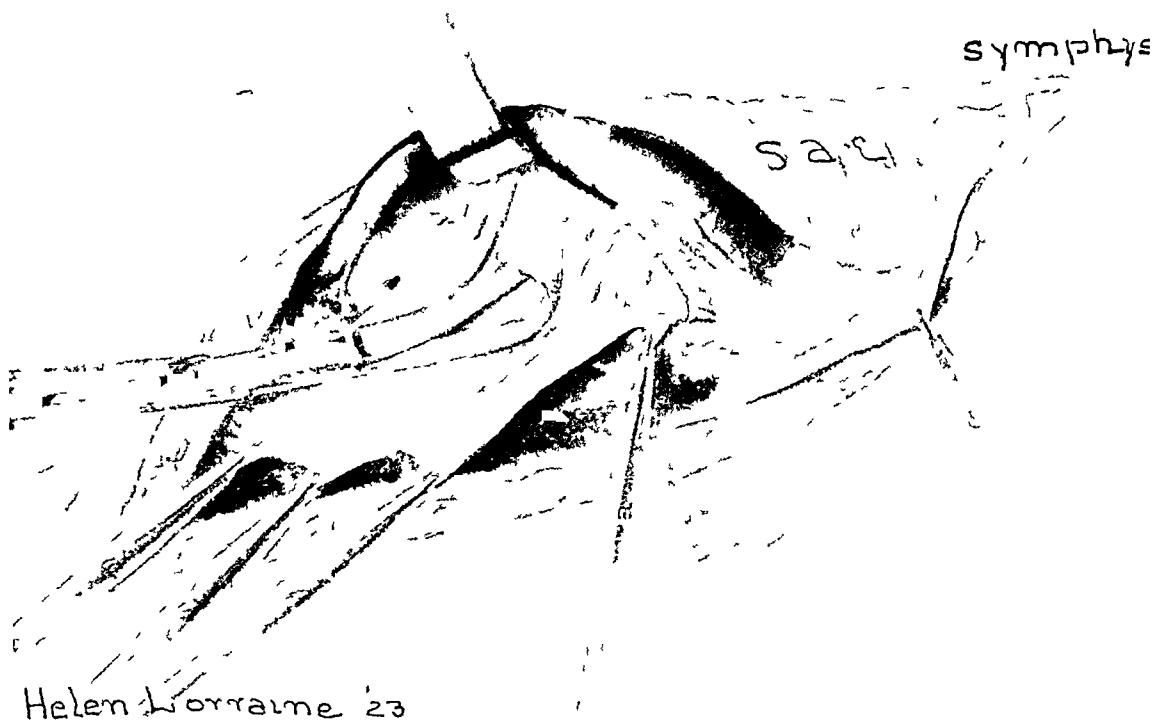


FIG 3 —The lower edge of incised peritoneum held flat and pulled upward, is easily separated by blunt blade scissors inserted into the space of easy cleavage between the peritoneum and infundibuliform fascia

and redundant peritoneum about its neck and of closure of the peritoneum well above the hernial orifice, the first and essential purpose of any method of cure of hernia

And finally with our present day conception of hernia as a definite anatomic structure (a peritoneal sac) of congenital, prenatal or post-natal origin it should be possible by means of a method permitting adequate open exposure of the entire region of operation, to remove successfully all of every hernia and its adjacent redundant peritoneum, employ needful plastic procedures as a part of wound closure and be assured at the conclusion of the operation that the hernia is permanently cured, and that unless serious wound infection or suture breakage should occur, post-operative rupture will not follow

In 1919³ and 1922,⁴ I published two papers illustrating a method of complete removal from within the peritoneal cavity, avoiding most of the

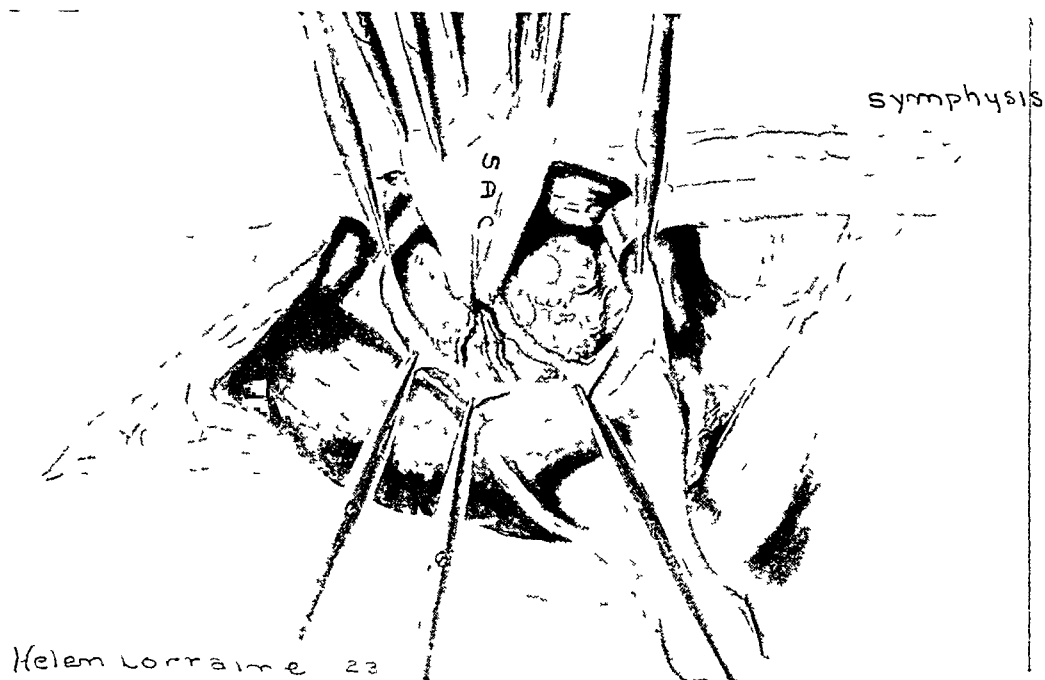


FIG 4 —The sac and adjacent peritoneum being pulled up is easily separated from the vessels vas deferens and fascia of the cord in easy view



FIG 5 —The sac almost removed

REMOVING HERNIA FROM WITHIN

well-known dangers, difficulties and disagreeable consequences incident to sac removal from without, and making the operation much more certain and easy of accomplishment. In this way I have operated upon more than 500 cases with progressive ease and satisfaction. During the past two or three years this method of enucleation of the sac and suture of the peritoneum has been distinctly improved and is now accomplished in the way herein illustrated. I first saw the advantage of the improved method in enucleating the sac of hernia associated with undescended testicle, and of anomalous types of sac, and now employ it routinely in all cases of hernia.

The usual incision is made through the skin, superficial fascia and aponeurosis of the external oblique, exposing the lower portion of the internal

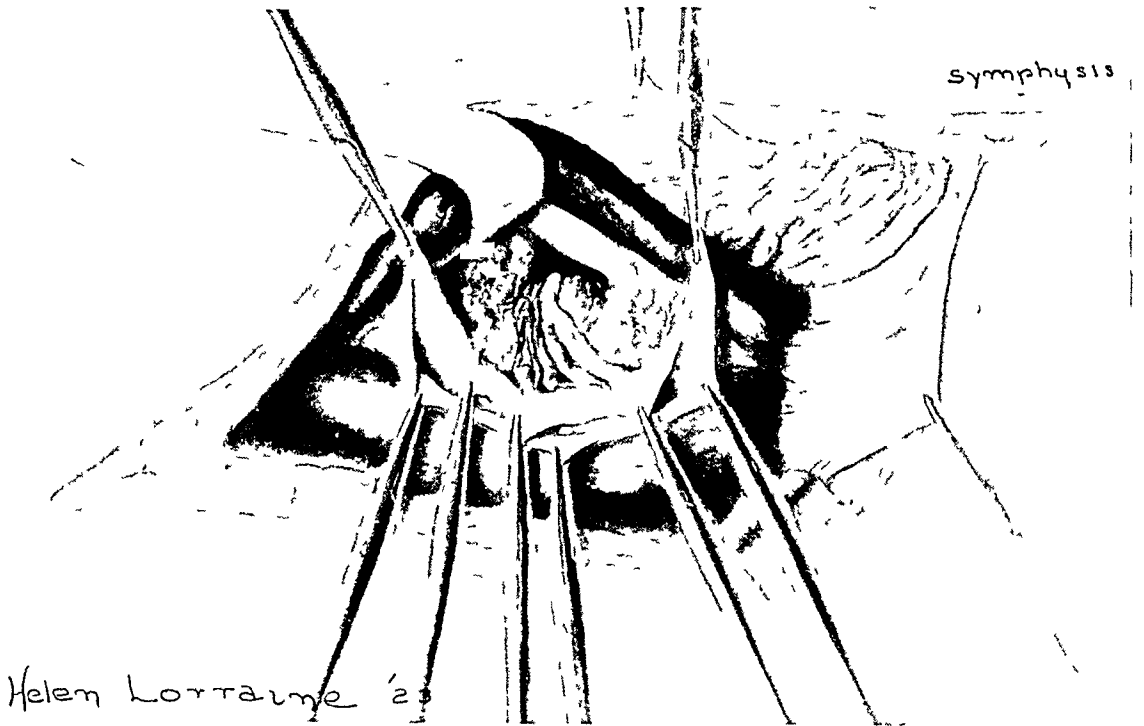


FIG 6 —The sac now entirely removed the edges of the incision in the peritoneum are held ready for suture. The peritoneum is easily freed from areolar tissue if necessary to do so, to suture without tension.

oblique, edge of the rectus, the contents of the inguinal canal and the shelving edge of Poupart's ligament (Fig 1). After separation of a bundle of fibres of the internal oblique and transversalis about an inch above their lower margin, the peritoneum above the hernia is exposed and opened (Fig 2). Bowel and omentum incarcerated in the sac and adherent above, may be safely and adequately separated and such operations as excision of omentum, bowel work and needful operations upon the pelvic organs performed. The hernial neck, adjacent peritoneum and position of the urinary bladder are now adequately exposed. The sites and exact types of indirect and direct inguinal, femoral, anomalous and combined herniæ, and the exact condition of such structures as the conjoint tendon, transversalis fascia, etc., are determined. The vas deferens, vessels of the cord, urinary bladder and large vessels covered by parietal peritoneum are exactly and easily identified. When needful to

release incarcerated bowel, omentum and other organs within the sac its neck may be cut or stretched from within exactly at the desirable spot with no danger of cutting other structures, without downward traction and consequent danger to the blood supply, permitting immediate reposition of bowel into the peritoneal cavity and more prompt restoration of circulation to areas of bowel threatened with gangrene. Traction upon the lower edge of the peritoneal incision by forceps placed near the bladder and well external to the position of the internal hernial ring, hold taut the redundant peritoneum which is now ready to be cut away (Fig 2). The posterior portion of the pelvic peritoneum well above the neck of the sac is easily picked up by forceps, cut,

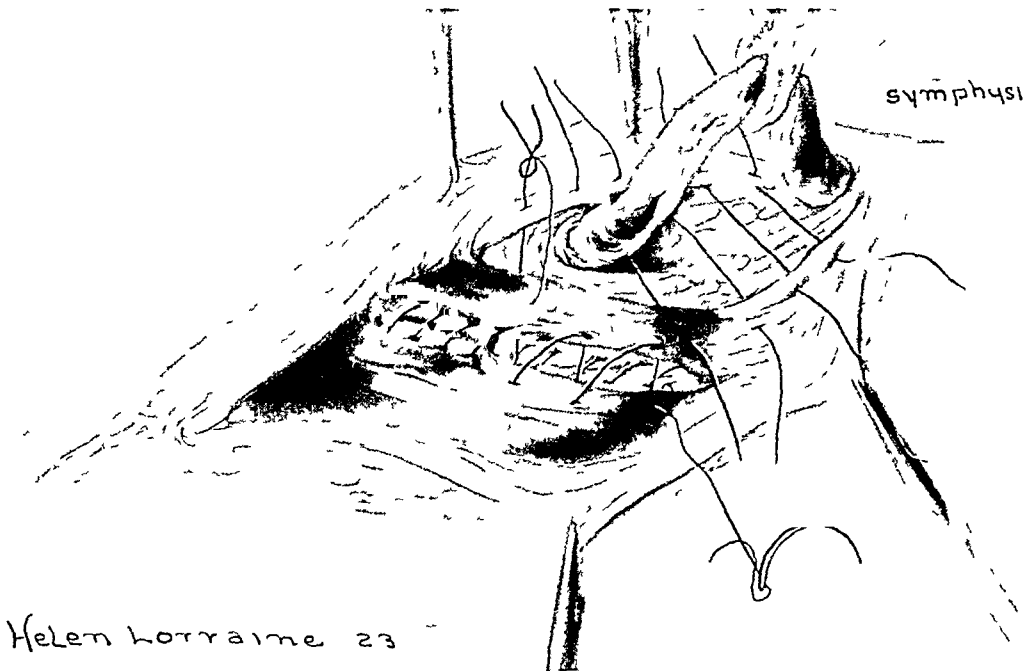


FIG 7—The peritoneum is sutured to a position much above the hernial orifice each suture catching the transversalis muscle and its fascia when present, the separated bundles of internal oblique are sutured and finally the canal may be closed in whatever method seems best in the individual case

and freed from underlying areolar tissue always as far inward as the bladder and outward well beyond the internal ring. This part of the peritoneum lifted by gentle traction away from its underlying areolar tissue is freed by blunt scissors enucleation with surprising ease. I have not encountered intimate adhesions of the peritoneum to the vessels or the vas deferens in this location. The anterior or lower portion of the parietal peritoneum is now held taut and flat by gentle traction upon the lower edge of the original incision into the peritoneal cavity (Fig 3). Blunt scissors are then inserted into the space between the peritoneum and the infundibuliform or cremasteric fascia where a natural line of cleavage exists. With gentle traction and blunt scissors or knife-handle separation, the hernial sac is readily enucleated (Fig 4) in the natural direction "with the grain" from beneath and with minimum trauma to the fibres and fascia of the cremaster, internal oblique and other muscles

REMOVING HERNIA FROM WITHIN

which may be utilized in wound closure With the urinary bladder, vas deferens and vessels of the cord continuously in view and the sac being continuously pulled away from them, these structures are gently brushed away (Fig 5) as enucleation proceeds and are at all times quite safe from injury Commonly there are only three points of intimate contact, namely the vas at the neck of the hernia, the bladder at the point of peritoneal attachment, and the deep epigastric vessels in front The latter, if adherent, may easily be tied and cut, the vas deferens need not be much traumatized, the bladder is not likely to be injured In some cases, especially in those who have worn trusses or who have been previously operated upon, and occasionally in others, the adhesions of the sac to the fascia may make separation less easy Once in a while the lowermost portion of the sac may be intimately related to the testicle or epididymis, but in no case is the difficulty of enucleation in this way equal to that encountered in the old way in freeing the sac from without and below upward With the entire sac and adjacent peritoneum in all directions removed, careful inspection of the field is made (Fig 6) If one chooses to do so, the internal orifice of the canal may be sutured I have not done so The peritoneum may easily be mobilized and sutured without tension By beginning the suture at the inner end near the bladder and catching with the peritoneum whatever transversalis fascia may exist or some muscle, the wound is closed quite like that of any other muscle splitting abdominal incision (Fig 7), and at a position much higher and further removed from the hernial ring than is likely to be the case after suture and ligation from below

Needful plastic procedures may now be employed, the wound closed by whatever method seems best for the individual case and one is quite able to know at the conclusion of the operation without having to wait months or years to determine, that the hernia and loose adjacent peritoneum are completely removed, and the peritoneum smoothly sutured high above the orifice and canal of the herniated sac

REFERENCES

- ¹ Halsted Quoted by Taylor Archives of Surgery, Sept, 1920
- ² Seelig and Chouke Archives of Surgery, Nov, 1923
- ³ LaRoque Surg, Gyn and Obstetrics, Nov, 1919
- ⁴ LaRoque ANNALS OF SURGERY, Jan, 1922

THE INFLUENCE OF HEMORRHAGE ON THE MORTALITY IN GUNSHOT WOUNDS AND OTHER INJURIES OF THE ABDOMEN*

A SUPPLEMENTARY REPORT WITH ANALYSIS OF 127 CASES

BY JAMES MONROE MASON, M D

OF BIRMINGHAM, ALABAMA

At the 1922 meeting of the Southern Surgical Association I presented a paper with the above title, reporting 69 abdominal injuries with a gross mortality of 59.4 per cent. This paper was published in *ANNALS OF SURGERY*, September, 1923.

Long observation had convinced me that this very high mortality was due not so much to the result of the visceral injuries as to the hemorrhage which was so often associated with them. The cases were, accordingly, subdivided into two groups, those with large hemorrhage, and those with small hemorrhage. In the large hemorrhage group, with extensive visceral injury were 37 cases, 34 deaths, 3 recoveries, mortality 91.8 per cent. In the small hemorrhage group, with extensive visceral injury were 19 cases, 6 deaths, 13 recoveries, mortality 31.5 per cent. Both groups were operated on promptly, by the same surgeons, in the same hospitals, and, as shown by one of the tables presented last year, received the same general type of visceral injury. The difference in the mortality rate was clearly demonstrated to be due to the amount of hemorrhage present.

It was pointed out that the usual methods of combating hemorrhage were unavailing, and that nearly all the patients in the large hemorrhage group died quickly from loss of blood, before sufficient time had elapsed for inflammatory or other complications to develop. It was insisted that these patients must be transfused if we hoped to reduce this mortality, and a plea was made for a systematic attempt on the part of every hospital organization to procure donors for these patients, and to make transfusion as much a part of the treatment as the laparotomy, in the "large hemorrhage" group.

I reported the case of a patient with ruptured spleen with enormous hemorrhage and a systolic blood-pressure of 66, who would have surely died if he had not been transfused, but who, after transfusion, was so much improved that splenectomy was successfully performed, and he recovered.

During the past year I have had the opportunity of observing the results of 58 cases of gunshot and stab wounds of the abdomen in St. Vincent's Hospital, the Hillman Hospital, and the Employees' Hospital of the Tennessee Coal, Iron and R. R. Co., the same institutions from which I obtained the statistics for my 1922 paper. Seven of these cases have been in my own service, fourteen in Dr. Lloyd Noland's clinic at the Employees' Hospital, and the remaining thirty-six, in the services of my associates, Doctors Talley, Ledbetter, Drennen, Moore, McCrossin, Leland, Lester, Solomon, Magruder, Davis, E. P. Hogan and G. A. Hogan, at St. Vincent's and Hillman Hospitals.

* Read before the Southern Surgical Association, December, 1923.

HEMORRHAGE IN INJURIES OF THE ABDOMEN

I have subdivided these cases into "Large Hemorrhage" and "Small Hemorrhage" groups in the same manner as was adopted in the series reported in 1922. I have also made a similar analysis of the combined group, 127 cases, as against 69 cases in my former paper, in order to emphasize by the greater number of cases the points presented in the previous paper, in an endeavor to strengthen the plea for transfusion, and thereby to reduce the high mortality of the large hemorrhage series.

The results in this year's series of 59 cases are practically parallel with those of last year, and the combined statistics in the 127 cases vary but little from those previously presented.

For the total series we have the following figures:

TABLE I

	1922	1923	Combined
Crushing injury (rupture of spleen)	1		1
Stab wounds	9	9	18
Gunshot wounds	59	49	108
Total cases	69	58	127
Deaths	41	33	74
Mortality rate	59.4	56.7	58.2

TABLE II—1922

Group No. 1—Large Hemorrhage Series

A—Cases not operated on by reason of collapse from hemorrhage when admitted

		Cases	Deaths	Mortality per cent
Gun shot wounds	9			
Stab wounds	1	10	10	100
<i>B</i> —Operative cases, large hemorrhage with extensive visceral injury				
Gunshot wounds	24			
Stab wounds	2			
Crush injury	1	27	24	88.8
Total	—	—	—	
		37	34	91.8

Group No. 2—Small Hemorrhage Series

A—Operative cases, no material hemorrhage, extensive visceral injury

		Cases	Deaths	Mortality per cent
Gunshot wounds	17			
Stab wounds	2	19	6	31.5
<i>B</i> —Explorations, wounds non-penetrating (5) or penetrating with no visceral injury (8)				
Stab wounds	9			
Gunshot wounds	4	13	1	7.6
Total	—	—	—	
		32	7	21.8

JAMES MONROE MASON

TABLE III—1923

Group No 1—Large Hemorrhage Series

A—Cases not operated on by reason of collapse
from hemorrhage when admitted

	Cases	Deaths	Mortality per cent
Gunshot wounds	5	5	100

B—Operative cases, large hemorrhage, extensive visceral
injury

Gunshot wounds	16			
Stab wounds	4	20	17	85
	—	—	—	
Total		25	22	88.8

Group No 2—Small Hemorrhage Series

A—Extensive visceral injury, no material
hemorrhage

		Cases	Deaths	Mortality per cent
Gunshot wounds	23			
Stab wounds	5	28	11	39.8

B—Explorations wounds non-penetrating (3) or
penetrating without visceral injury (2)

Gunshot wounds		5	0	0
		—	—	
Total		33	11	33.3

COMBINED STATISTICS 1922 AND 1923 CASES

TABLE IV

Group No 1—Large Hemorrhage Series

A—Cases not operated on by reason of collapse
from hemorrhage when admitted

		Cases	Deaths	Mortality per cent
Gunshot wounds	14			
Stab wounds	1	15	15	100

B—Operative cases—Large hemorrhage, exten-
sive visceral injury

Gunshot wounds	40			
Stab wounds	6			
Crushing injury	1	47	41	87.2
	—	—	—	
Total		62	56	90.3

HEMORRHAGE IN INJURIES OF THE ABDOMEN

Group No 2—Small Hemorrhage Series

A—No material hemorrhage, extensive visceral injury

		Cases	Deaths	Mortality per cent
Gunshot wounds	40			
Stab wounds	7	47	17	36.1

B—Explorations—wound non-penetrating (8) or penetrating with no visceral injury (10)

Gunshot wounds	9			
Stab wounds	9	18	1	5.5
	—	—	—	

Total		65	18	29.2
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The extreme difficulty encountered in obtaining donors for the class of patients composing this series still exists. In my own cases no large hemorrhage occurred, so the necessity for transfusion did not present itself to me in my 1923 work.

Only one transfusion is recorded in the 1923 series, a case operated on by Dr. S. L. Ledbetter, Jr. This case serves to demonstrate, as did my transfusion in ruptured spleen reported last year, the wonderful effect of transfusion on a patient doomed, without it, to a speedy death.

The details, in brief, are as follows: The patient, a colored male, age twenty, was shot by an officer, November 13, 1923, at 10:50 P. M. He was admitted to the Hillman Hospital at 11:15 P. M., and was operated on November 14, 12:25 A. M., one hour and thirty-five minutes after being wounded.

Laparotomy revealed two perforations of stomach which were sutured and a perforating wound of the liver, which also was sutured and drained. The abdomen was full of blood. The pulse became so rapid and weak that the patient almost died on the table, and further search for injuries was abandoned. The patient received 750 cc of salt solution intravenously, and other stimulants, but did not improve. At 3 A. M. a donor was obtained and a transfusion of 500 cc of blood was given. He rallied at once and made an uninterrupted recovery.

CONCLUSIONS

To secure a reduction in the mortality rate of the small hemorrhage series, which stands at 36.1 per cent where there is visceral injury, we must depend upon early operation, refinement of surgical technic, lessening the shock of prolonged ether anæsthesia by a more extensive use of local anæsthesia, nitrous oxide or ethylene anæsthesia, and the most careful attention to the details of after treatment.

To secure a reduction in the mortality of the large hemorrhage series, which stands at 87.2 per cent in the operative cases, all the requirements above noted must be observed, and donors for transfusion must be obtained regardless of trouble or expense.

PARTIAL GASTRECTOMY FOR GASTROJEJUNAL ULCER*

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THE basic principle in the surgical treatment of peptic ulcer is adequate drainage of the stomach. Whether gastro-enterostomy, partial gastrectomy, or pyloroplasty is performed, the surgeon recognizes the necessity of a large

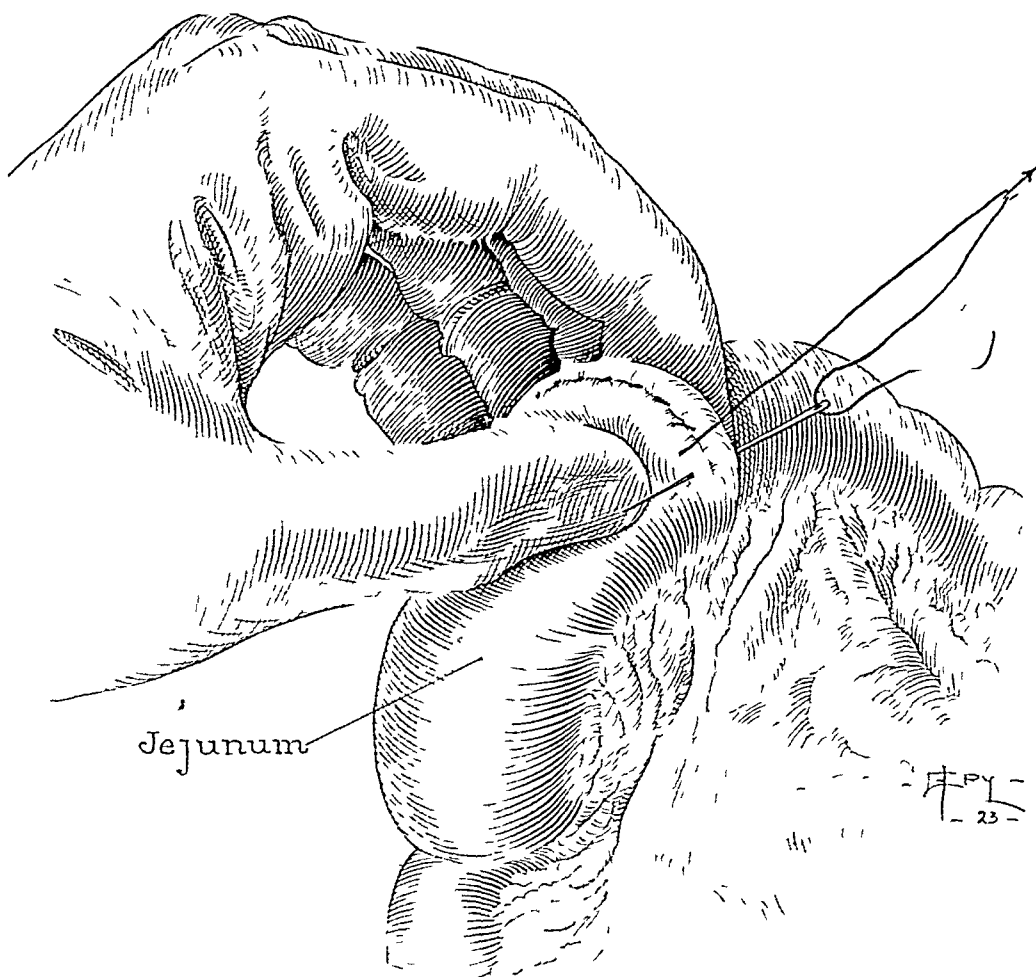


FIG 1 — Continuous suture closing jejunum after it has been removed from the stomach

and properly placed communication between stomach and small intestine. The efficiency of gastro-enterostomy, and its consequent popularity, are largely dependent on the excellent drainage provided by the properly performed operation. In duodenal ulcer, gastro-enterostomy, combined, when necessary, with excision of the ulcer, gives 95 per cent of satisfactory results.

* Read before the Southern Surgical Association December 11, 1923

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and a mortality rate between 1 and 2 per cent , in gastric ulcer, if combined as a routine with cautery or knife excision of the ulcer, 90 per cent satisfactory results and a mortality rate between 2 and 3 per cent are obtained

Failures under such management are seldom complete since those patients

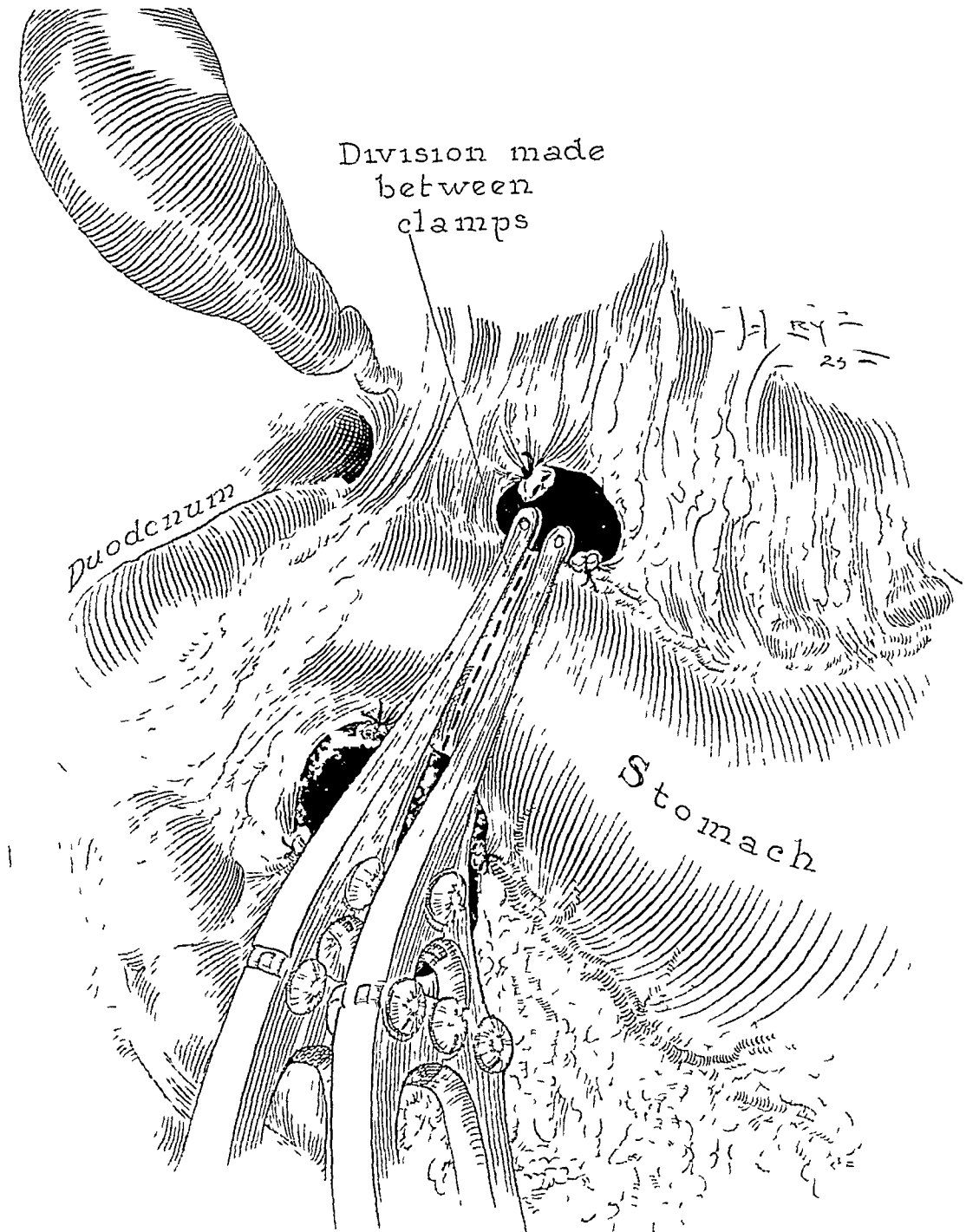


FIG 2 —Two Payr clamps are placed on the pylorus, openings being made in the gastrohepatic omentum

who do not consider the results satisfactory have usually experienced partial relief from their symptoms, and find it possible to control the slight digestive disturbances by dietary discretion and simple medication. The most serious sequel of gastro-enterostomy is gastrojejunal ulcer. It occurs apparently,

in about 2 per cent of cases, which represents the average incidence in large series of gastro-enterostomies reported by different surgeons. The real cause, or causes, of the ulceration are not known, because when all the factors possibly concerned in its formation, such as persisting hyperacidity, errors in technic, neglect in post-operative care, unabsorbable sutures, unremoved

foci of infection, are eliminated, ulceration may still occur. The cause of gastrojejunal ulcer, therefore, is as uncertain as is the cause of peptic ulcer.

Gastrojejunal ulcer manifests itself in no uncertain manner, the symptoms are usually easily recognized clinically, and its presence can be confirmed by fluoroscopy. The patient experiences the usual good health and freedom from symptoms for from six months to one year. With the exception of the few cases in which the first symptoms are those of a complication, such as perforation, hemorrhage, or vomiting from obstruction at the stoma, the onset is gradual. Pain associated with the ingestion of food (usually one to two hours after meals) gradually appears and is resistant to ordinary measures of treatment. The pain is usually lower (often to the left of the middle line) than in

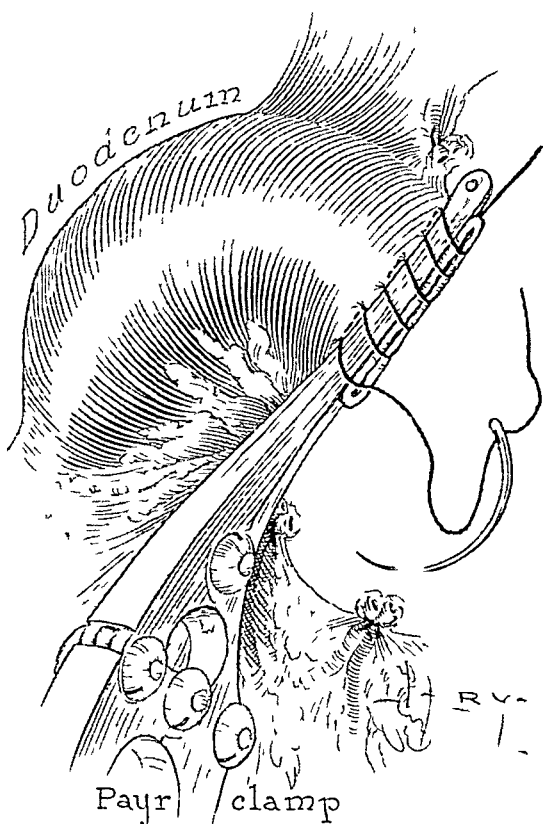


FIG 3—First suture placed in the duodenum. Suture passes through the anterior and posterior walls of the intestine and around the Payr clamp.

peptic ulcer, and is of great diagnostic significance. It increases in severity, and may be accompanied by vomiting, which often gives temporary relief. The majority of patients seek surgical relief early. If any doubt remains whether an ulcer is present or not, fluoroscopic examination will give positive information in more than 95 per cent of cases. Since experience has shown that early surgical treatment is safe and satisfactory, operation should not be postponed, because a cure by medical means is extremely rare (Paterson says that 100 per cent of patients not operated on die) and the lesion tends to progress in size, and in complications. Delaying operation means a patient in poor condition, an extensive lesion, a difficult and serious operation, and uncertain results.

The surgical management of gastrojejunal ulcer is varied, but it always necessitates an operation of considerable magnitude. In the Mayo Clinic,

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168 gastrojejunal ulcers have been operated on, eighty-six of our own cases in a series of 6192 gastro-enterostomies, and eighty-two cases in which the original operations were performed elsewhere. The method of treatment has been either (1) excision of ulcer, when small, with enlargement of the original anastomosis, (2) cutting off the gastro-enterostomy, excising the lesion, closing the openings in jejunum and stomach, and pyloroplasty, or (3) cutting off the gastro-enterostomy, excision of the lesion, closing the opening in the jejunum, resecting the pyloric end of the stomach, including the opening of the anastomosis, with restoration of continuity by whatever method is best suited to the case. The latter operation, partial gastrectomy, has such distinct advantages, particularly in its end results, that I bring it to your attention.

Patients with gastrojejunal ulcer, especially those with unusually severe symptoms, or with symptoms of long standing, are usually benefited by a course of pre-operative treatment. Hospitalization for a few days, during which time the stomach is kept at a minimum of activity, fluids given by rectum

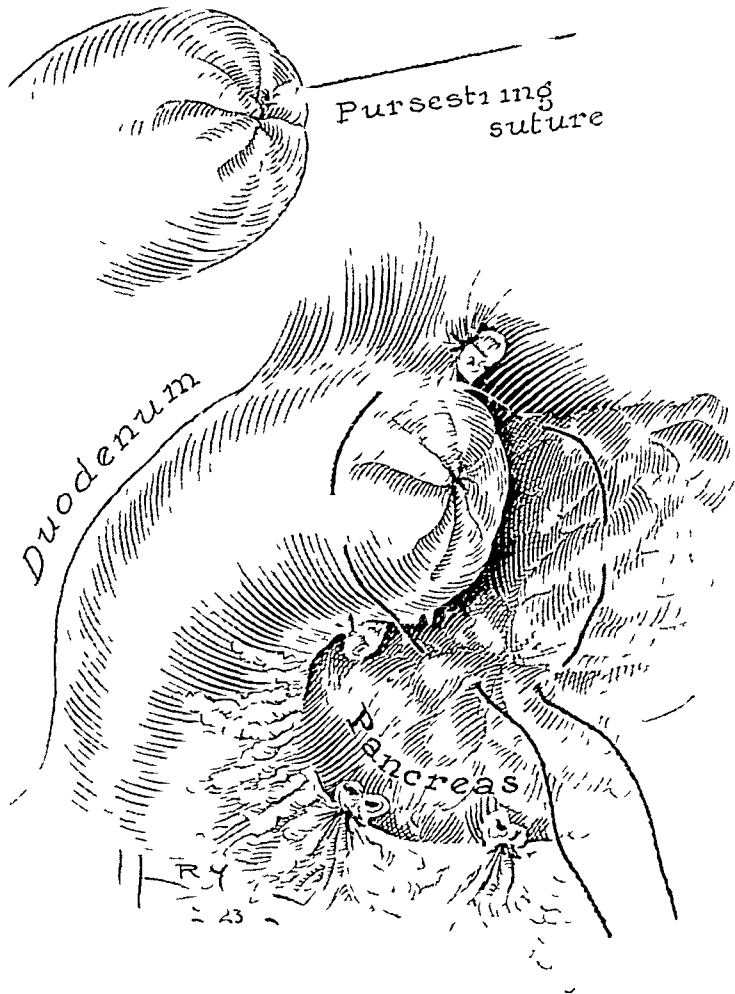


FIG 4—Purse-string suture in duodenum and pancreas to invert duodenal stump

and hypodermaclysis, and, if there is marked anæmia, one or more transfusions, will bring the patient to a point of maximal improvement, and lessen the activity of the inflammation in the region of the lesion. Since the operation may be protracted, it is advisable that as much as possible should be performed under ethylene or local anæsthesia, preceded by morphin and atropin given one-half hour before operation. Exploration usually reveals the induration characteristic of the lesion in the anterior line of the anastomosis, and this induration varies in extent from a small area of the anastomosis to one involving the entire circumference of the anastomosis with extension to neighboring structures. The mesocolon is always involved,

the transverse colon occasionally, possibly with formation of a gastrojejuno-colic fistula, and the anterior abdominal wall rarely. The anastomosis is first mobilized. This may necessitate separation from the colon, and if an opening is present in the latter, it is closed and protected as well as possible by omental tissue. If no opening can be demonstrated, but considerable necrosis of the wall of the colon has occurred, this area of the bowel should be wrapped in omentum and a few sutures placed so as to maintain the protection. The

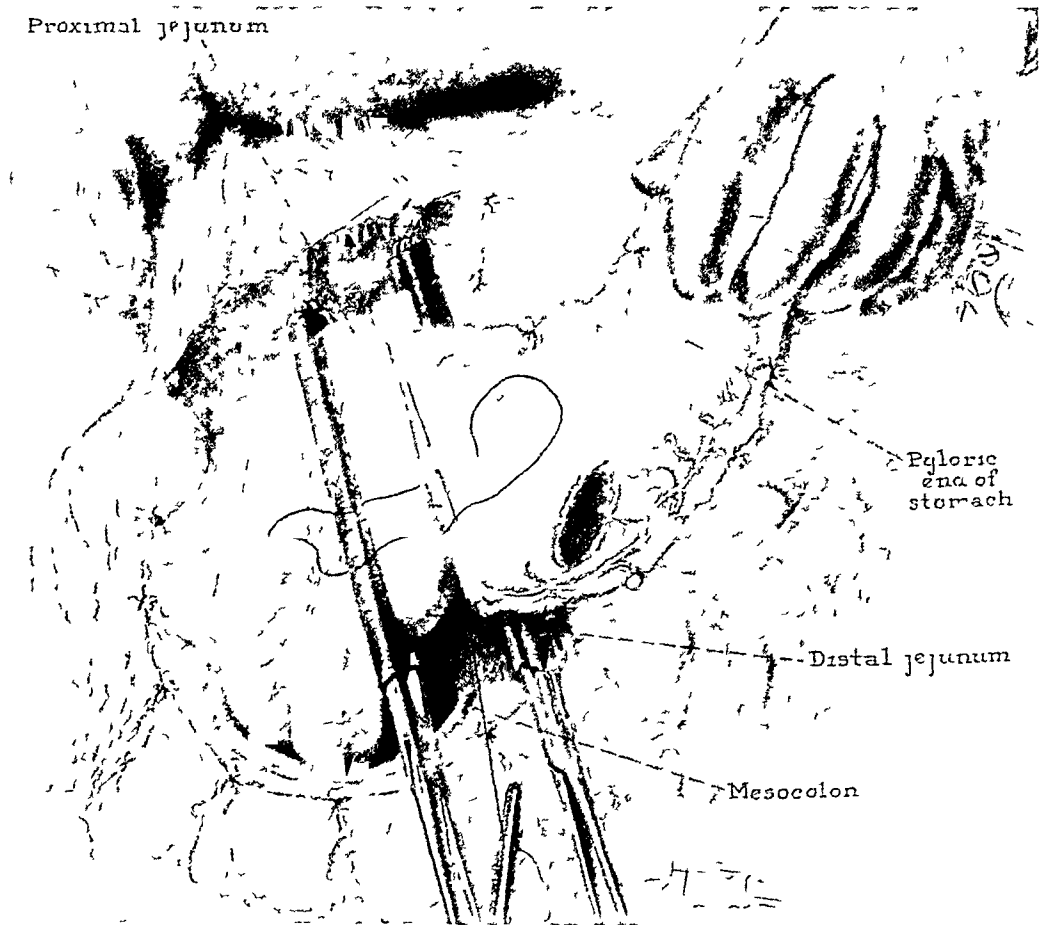


FIG 5 —The first row continuous serous suture approximates jejunum and stomach. Old gastro enterostomy opening on posterior wall of the stomach.

colon being disposed of, the anastomosis is inspected. If the induration is slight and is readily excised, this may be done and the anastomosis reconstructed on a larger scale. However, there is a growing tendency in the Clinic, even when lesions are small, to disconnect the anastomosis, excise any ulceration of the jejunum, close the opening in it, and perform partial gastrectomy. The basis for this radical procedure is the fact that if an operation, such as gastro-enterostomy, which prevents the recurrence of ulcer in more than 95 per cent of cases, fails to prevent recurrence, it is because for some reason the patient has a very unusual liability to ulcer formation. Since the cause of this liability is unknown, it is logical to remove the portion

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of the stomach in which ulcers usually occur. The anastomosis, then, is mobilized, and the actual union of stomach and jejunum exposed as clearly as possible. The anastomosis is encircled with the thumb and first two fingers of the left hand, and the line of anastomosis is cut across with large heavy

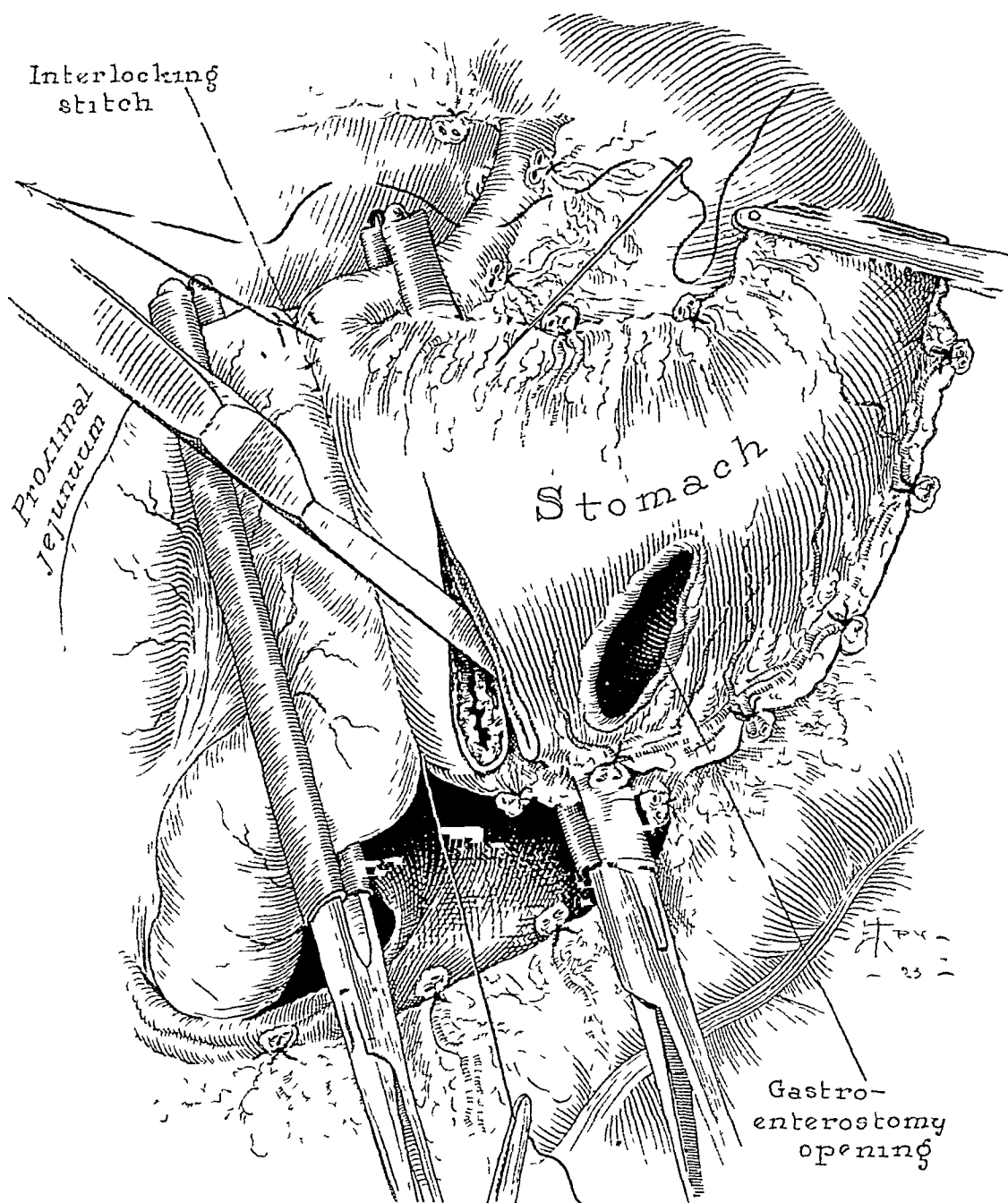


FIG 6 —The pyloric portion of the stomach is resected distal to the suture line

scissors, leaving, if possible, an excess of tissue on the jejunal side. The opening in the stomach is covered with a gauze pad, and the opening in the jejunum closed. This closure is made by two rows of continuous chromic catgut in a transverse direction, and the lumen is maintained during the closure by the thumb and first finger approximated under the suture line (Fig 1). I have not seen obstruction take place at this point. The stomach is then

resected. The method recently described by Walton has certain advantages. The pyloric and the right gastro-epiploic vessels are first ligated, the pylorus divided, and the duodenum inverted (Figs 2 and 3). If a lesion exists in the duodenum with fixation of the pylorus, it may be disregarded, and the stump of duodenum inverted in the usual way (Fig 4). The pyloric end of the

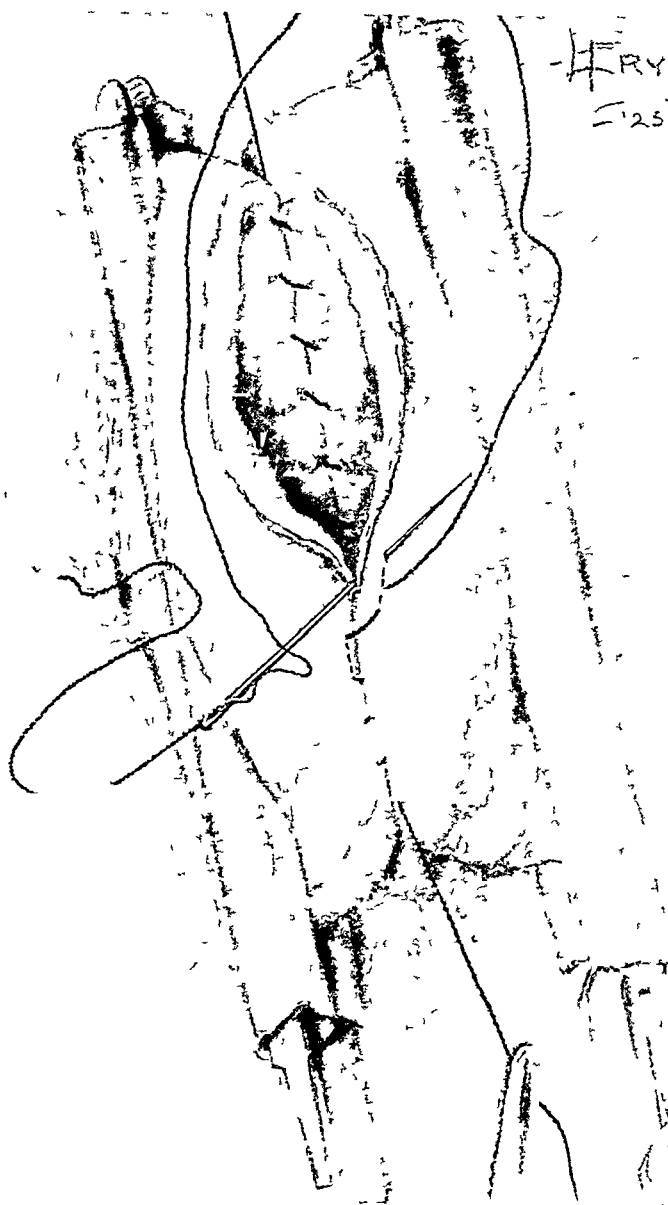


FIG 7—Continuous suture in anterior walls of jejunum and stomach. Suture passes through all coats.

stomach is then mobilized by ligation in sections of the gastrohepatic omentum, and the gastro-colic omentum and the vessels along the lesser and greater curve ligated to a point 25 cm beyond the line at which the resection is to be made. Ligation of the gastric artery is easier by this method than before the stomach is mobilized. A long rubber-covered clamp is placed as high as possible on the stomach, which is then turned over to the left (Fig 5). If the resection is not to be too extensive, the jejunum is brought up through an opening in the mesocolon and a segment of it caught in a rubber-covered clamp and approximated to the stomach for an end-to-end anastomosis, the proximal end of the loop of jejunum being at the lesser curve of the stomach. The first suture line of chromic gut (seromuscular) now unites jejunum and stomach. When this has

been placed, the operative field is well protected, and the stomach is divided on a line about 13 cm from this suture line. This method of placing the first suture line before the stomach is cut away, prevents its retraction into a position where suturing would be awkward. The clamp still being on the stomach, hemorrhage from the cut end is partially con-

PARTIAL GASTRECTOMY FOR GASTROJEJUNAL ULCER

trolled, the pocket of the open end is swabbed out, an opening of corresponding size made in the jejunum, and the anastomosis completed in the usual way (Figs 6 and 7) Before the posterior aspect of the anastomosis has

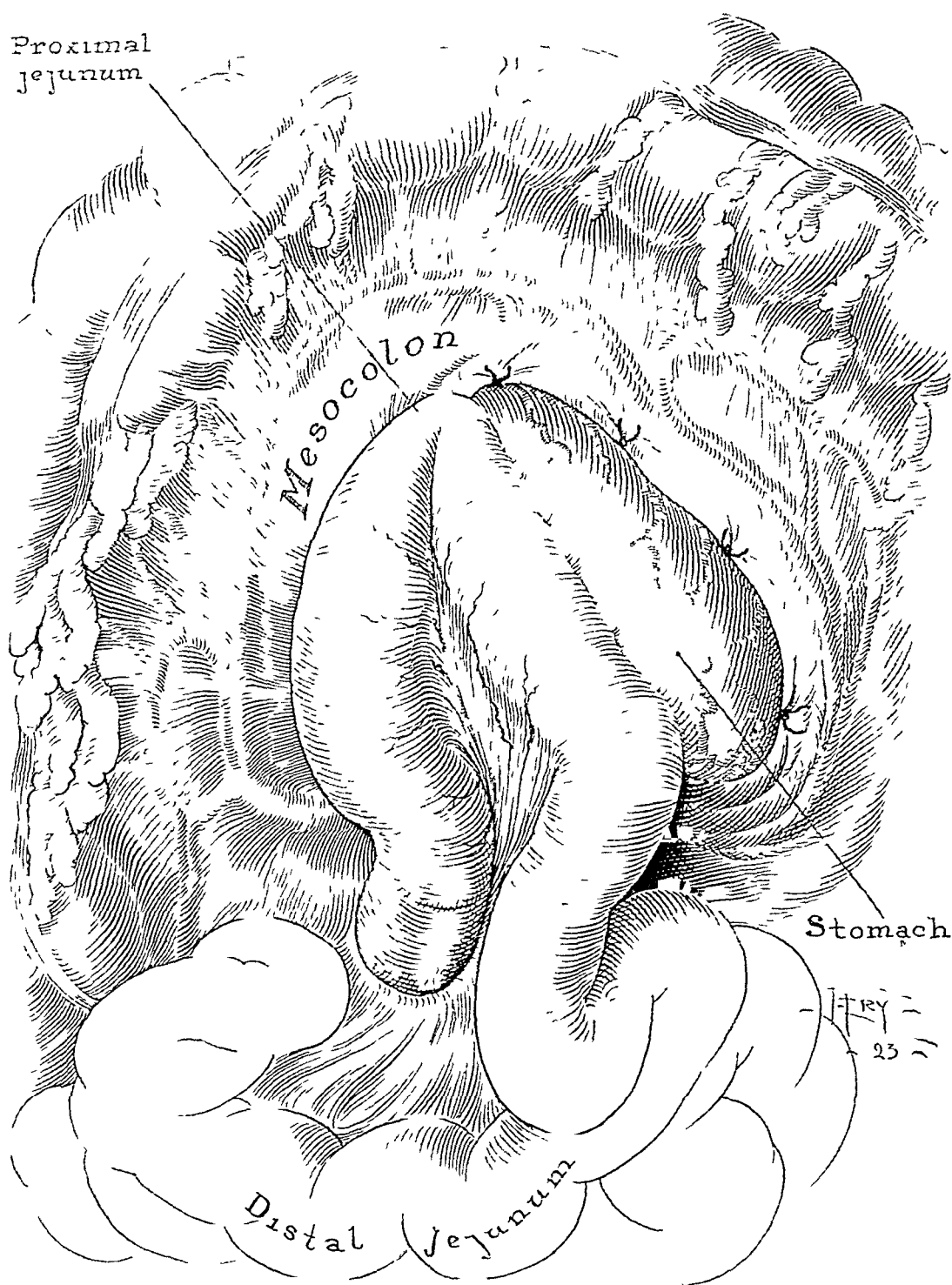


FIG 8 —Completed operation viewed from under side of the mesocolon

disappeared from view, the clamps on both jejunum and stomach are temporarily loosened, any oozing from the posterior suture line is controlled by a transfixing suture, and any vessels in the unsutured anterior edges which can be ligated are so dealt with When the anastomosis is complete, one or

more tension sutures are placed at the lesser curve between jejunum and stomach to counteract any undue drag on the actual suture line at that point. The whole anastomosis is then drawn down through the opening in the mesocolon, and the edges of the latter structure are sutured to the stomach at as high a point as possible (Fig 8). If the resection has been of sufficient extent to make a posterior anastomosis inadvisable or difficult, the jejunum may be brought up in front of the colon, and the anastomosis made as described.

We are finding increasing indications for partial gastrectomy for gastrojejunal ulcer, including its complications, colon fistulas, and so forth, and in twelve cases there has been no mortality. In view of the serious condition of many of these patients, the extensive inflammatory products in the operative field, and the fact that several operations had been performed on some of them, this is very gratifying. The results thus far have been excellent. I am convinced that partial gastrectomy is the operation of choice in the majority of such cases.

SURGERY OF RENAL TUBERCULOSIS *

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TUBERCULOSIS is one of the most common and destructive of the surgical conditions of the kidney, an organ which apparently furnishes abundant soil, satisfactory for the location and growth of the bacillus of tuberculosis. In the early stages the lesion is small and well localized, and good results can be obtained from surgical procedures. Like pulmonary tuberculosis, now ordinarily recognized and provided for, renal tuberculosis often results in death. Wildbolz, in a series of 5338 necropsies, found that 158 (2.9 per cent) of the deaths were due to renal tuberculosis. Schlesinger, in 2345 necropsy reports from the Berne Pathologic Institute, found renal tuberculosis in 5.3 per cent of cases, in 20.7 per cent of which there was pulmonary tuberculosis also. Hansen, in 462 fatalities due to tuberculosis, found that death was due to renal infection in 12.8 per cent. Kummell gives a more favorable report, in only 1.19 (0.5 per cent) of 40,621 necropsy reports from the Eppendorfer Clinic was death due to renal tuberculosis.

Renal tuberculosis is primarily unilateral and is essentially a surgical disease. Israel asserts that there is no non-operative cure, and Wildbolz that it is a disease which only rarely is healed spontaneously. It is questionable whether healing ever takes place without operation. On the other hand, in rare cases relatively good health may be enjoyed for many years, even if the renal tuberculosis is extensive. Wildbolz reported cases in which patients with renal tuberculosis lived without marked discomfort for from ten to thirty years. The infection may be well localized, of low virulence, or the individual may, by reason of chronicity and numerous foci of infection, have acquired a tolerance and resistance to the bacillus. Braasch³ believes that immunity develops with multiplicity of lesions. With removal of the renal focus, complete recovery may take place. In most cases the infection destroys the kidney, spreads locally, extends to the bladder and often causes disease of the other kidney. Kummell found only five bilateral infections in 100 surgical cases of renal tuberculosis. On the other hand, in eighty-one of 119 necropsy cases the condition was bilateral. Wildbolz found that death occurred in ninety-nine of 316 non-operative cases during the first or second year after the onset of symptoms, only 20 per cent of patients lived more than five years.

* Read before the Southern Surgical Association, December 11, 1923

In 200 cases treated conservatively, reported by Kornfeld, only five patients lived more than six years

Between 1894 and 1923, 874 cases of tuberculosis of the kidney have been treated surgically at the Mayo Clinic. The kidney was removed in 863 cases, exploration only was performed in nine. Five hundred and fifty-six (63.6 per cent) of the patients were men, and 318 (36.4 per cent) women. In eighteen cases the opposite side was also tuberculous. Complete post-operative data were obtainable in 611 (69.9 per cent).

Age of Patients Renal tuberculosis is most common during early and middle adult life, 84.7 per cent of the cases in this series occurred between the ages of twenty and fifty years, 21.7 per cent of the patients died an average of four years after nephrectomy.

Definite localizing symptoms of renal tuberculosis in children are few and difficult to recognize. Until the last decade, such cases were rarely observed clinically, but necropsy records demonstrated that this disease was relatively frequent. The kidneys apparently have a predilection for tuberculosis in early life. Vignard found the kidney affected in thirty-three of 100 tuberculous children. He collected 138 cases of chronic renal tuberculosis in children, twenty-one of whom were less than ten years of age. Dickinson found renal tuberculosis in 16.2 per cent of 300 children dying from tuberculosis. Vignard believes that the cavernous form is the most common, it increases the size of the organ, and resembles pulmonary tuberculosis. The kidney may be completely destroyed and reduced to a mere sac. A perinephritic infection is not uncommon and is a serious complication. Twelve of thirteen primary nephrectomies in young children in Vignard's collected cases were successful, one child died. Fifty-five (63 per cent) of the patients in our series were less than twenty years of age. Thirteen (23 per cent) are dead.

Renal tuberculosis rarely occurs in persons more than sixty years of age. Kuster found ten of 335 patients more than sixty years, four were more than seventy. Wildbolz found forty-six of 561 patients more than sixty years old, eleven were more than seventy. Seventy-one of the patients in our series were more than fifty years, eighteen (25.3 per cent) are dead.

Surgical Procedures—Primary nephrectomy is the operation of choice. Conservative surgical procedures are not practical in cases of tuberculous kidneys, and at best, afford only temporary relief. Pousson collected sixty-three cases of nephrotomies for tuberculosis, thirty-nine (61.7 per cent) of the patients died. Schmeiden reported seven cases of partial resection, in three the wound healed, in one it healed with a fistula, in two a second nephrectomy was necessary, one patient died. Partial resection for tuberculosis is generally a failure even in cases of double kidney owing to the fact that an apparently normal renal segment is usually well studded with tubercles. Minute areas of infection may be found readily on histologic examination. Surgical trauma may light up a quiescent area of infection and

require further operation later. In an earlier paper⁴ a series of cases of double kidney were reported in which nephrectomy was performed for a tuberculous process apparently limited to one segment. On histologic examination it was found that the intervening tissue and the grossly normal segment were often definitely tuberculous.

Nephrectomy The usual procedure in the Mayo Clinic is simple extra-peritoneal lumbar nephrectomy. The lumbar incision exposes only a limited, easily drained area, provides a satisfactory approach for even large caseating and hydronephrotic kidneys, and leaves the peritoneal cavity intact in most cases. The postero-lateral incision, starting at the costo-vertebral angle, extends downward and forward to a point midway between the crest of the ilium and the last rib. The latissimus dorsi, external oblique and internal oblique muscles are cut, care being taken not to injure the branches of the iliohypogastric and ilio-inguinal nerves. The transversalis fascia is opened between these two nerves. The erector spinæ muscles may either be partially cut or retracted toward the spine. The quadratus lumborum muscle and the costo-vertebral ligament are cut, if necessary, to complete the exposure. The peritoneum is retracted forward, and only rarely is in danger of being torn if the approach to the kidney is made at the posterior angle of the incision. The kidney is reached by tearing through the perirenal fat, which is generally adherent, œdematous, and not infrequently also infected, if the kidney is tuberculous. As much as possible of the perirenal fat should be removed, since if allowed to remain, it may cause persistent drainage. Tuberculous kidneys, unless they are hydronephrotic, occluded, or have been operated on, are, in most cases, not markedly adherent nor enlarged. The pedicle is clamped with two heavy forceps. If there is evidence of much fluid in the kidney, it may be necessary to avoid contamination by placing a third pair of forceps close to the kidney, the pedicle is cut between this forceps and the two hæmostatic clamps. The pedicle is firmly ligated and the inner clamp removed, the second ligature is tied while the second clamp is being removed.

Subcapsular Nephrectomy In certain cases of extensive perirenal adhesions or in which fixation has resulted from previous operative procedures, it is necessary to perform subcapsular nephrectomy. This operation was performed in thirty-five cases in our series. In most of these cases, protective adhesions to the fibrous capsule are firmly fixed to the kidney, making it more difficult to remove, but apparently the mortality is no higher than that following simple nephrectomy, but as a rule, the retained capsule and perirenal fat cause more persistent drainage. If this is a second operation, the incision is carried down through the fistulous opening, which usually exists. If it is impossible to free the surrounding adhesions, the incision is continued until the kidney is reached. The capsule is folded back and clamps are applied, as in simple nephrectomy. On account of the œdema and friability of the mass held by the clamps, it is sometimes advisable to leave the clamps in place for seventy-two hours without attempting to ligate the pedicle. In certain cases, if the capsule

is not thick and œdematous, it may be turned back and cut at the pedicle, the kidney may then be pulled through the opening, exposing the renal vessels, which may be ligated directly (Fig 1)

Transperitoneal Nephrectomy The abdominal route is only rarely employed for the removal of tuberculous kidneys. Before our present methods of accurate urologic diagnosis existed, tuberculous kidneys were sometimes encountered and removed during the course of abdominal operations. The mortality was high following any type of nephrectomy in these early cases, and the added risk of peritoneal infection was not considered an important

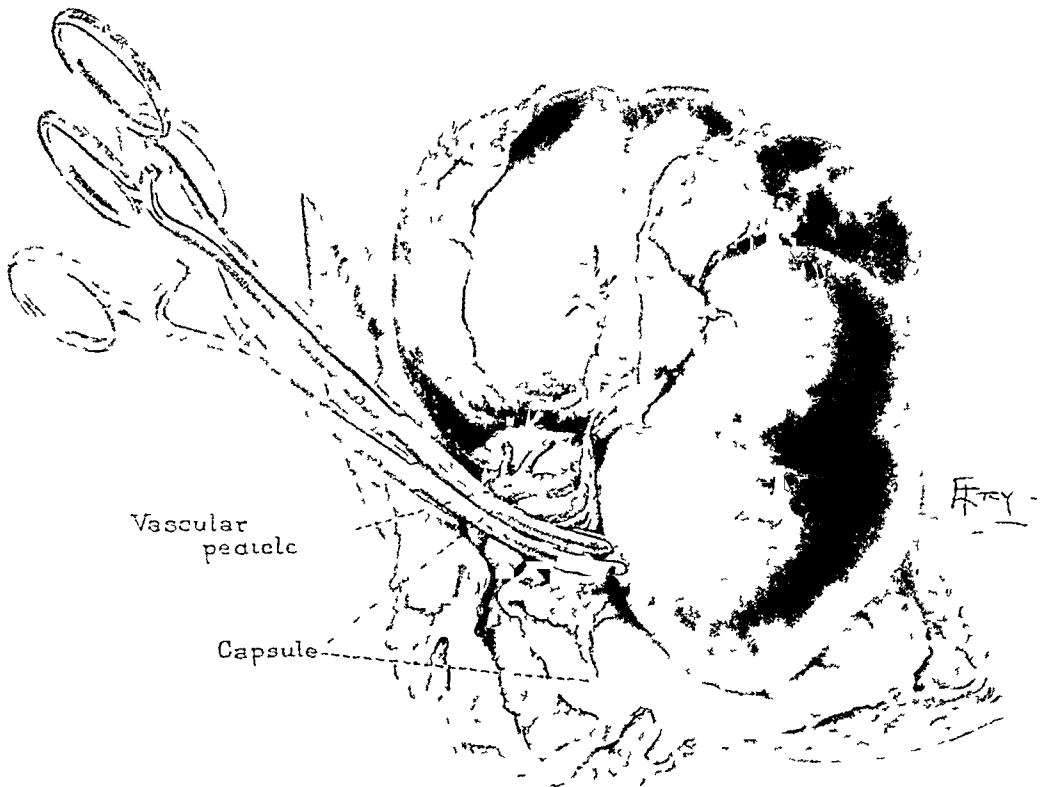


FIG 1—Subcapsular nephrectomy. The capsule has been cut freeing vascular pedicle so that it may be drawn up for ligation.

mortality factor. Kuster collected thirty-one cases of transperitoneal nephrectomy for tuberculosis, sixteen (51.6 per cent) patients died following operation. Seventy-nine (29.3 per cent) of 269 patients who had had lumbar nephrectomy died. Since then, improved surgical technic and more satisfactory methods of approach have greatly reduced the dangers from lumbar nephrectomy, but the risk of peritoneal infection from transperitoneal operations persists. Not infrequently, small kidneys without secondary infection and with well-encapsulated tuberculous lesions are removed transperitoneally without causing contamination. Tuberculous kidneys may be present as abdominal tumors, or may be too large to remove by the lumbar route. In large acute hydronephrotic kidneys there is generally a severe type

of infection, and if extensive soiling occurs, secondary peritonitis may readily follow. Occasionally acute miliary tuberculosis may arise. Sometimes a tuberculous renal mass may rupture directly into the peritoneal cavity, causing localized peritonitis and necessitating a transperitoneal approach.

Disposal of the Ureter

In most cases a portion of the ureter is removed. If it is strictured and dilated, it is desirable to remove as much as possible. Like the bladder, the ureter rarely remains infected after a tuberculous kidney has been removed. The extensive operation necessary to remove the entire ureter, exposing a wide area to infection and absorption, greatly increases the operative risk, and is rarely indicated (Fig 2).

Various methods of disposing of the remaining stump of the ureter have been employed. Kocher injected iodine and Israel carbolic acid into the ureter. Kummell employed an especially constructed thermocautery to obliterate the ureteral lumen. Zuckerkandl closes the wound completely, sutures the ureter to the lower angle of the wound ligates, and cuts it at the end of the operation. After absorption of the catgut suture, the ureter withdraws into the depths of the wound. Walters, in a review of the Mayo Clinic

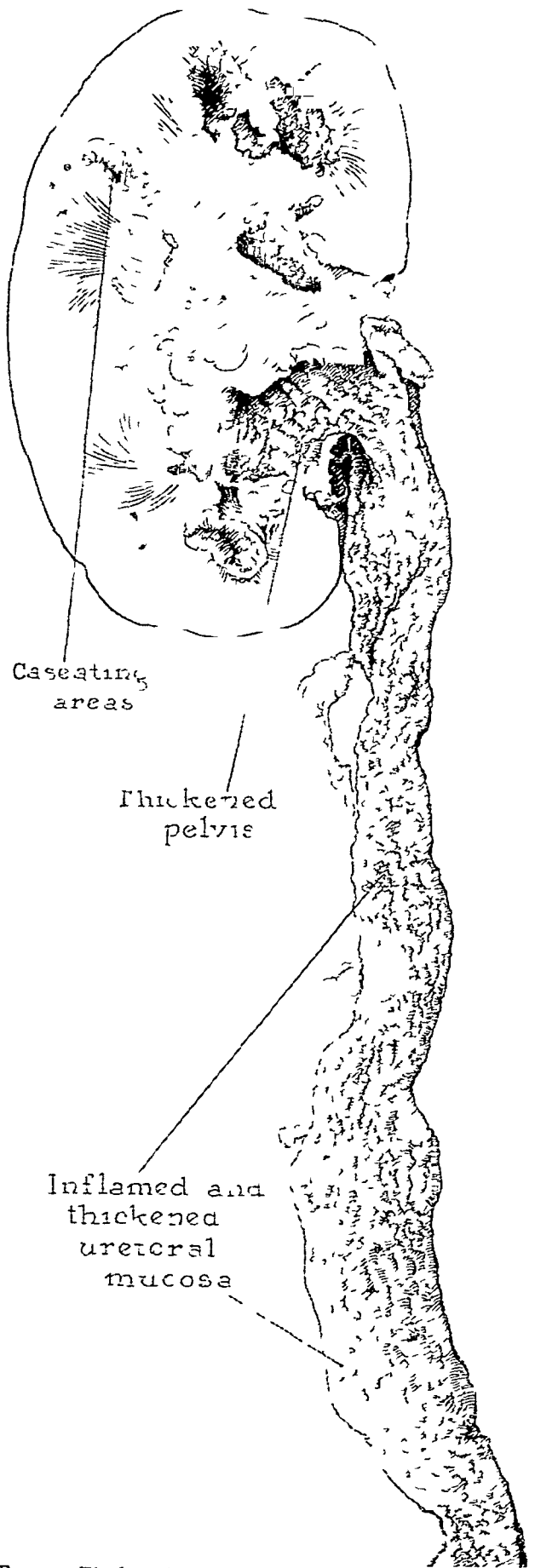


FIG 2 —Thickened dilated ureter which contained a large amount of infected material

cases, found that the ureter was usually cut with the cautery and the retained end ligated with catgut. In an earlier paper,⁹ we described a method in which this ligated, infected portion of the ureter was isolated and brought to the surface of the wound through a section of rubber tubing, which also serves as an exit for wound discharges. W. J. Mayo cuts the ureter with the cautery, allows the bladder portion to drop back, and closes the wound without drainage.

Wildbolz separates the ureter with the cautery and ligates the lower end. Israel, in a review of 1023 cases of nephrectomy for tuberculosis, says that the method of treating the ureter has no marked influence on the formation of fistula.

Pleura and Peritoneum —

In certain cases, perinephritic adhesions are so extensive that it is impossible to remove the kidney without opening one of the large cavities of the body. These openings should be sutured immediately. If there is no free perirenal infection and if the operation is completed without marked soiling, post-operative complications are rare. In certain other cases, both the pleural and peritoneal cavities may be opened during operation, without causing the post-operative convalescence to vary from that following an ordinary nephrectomy. In an occasional

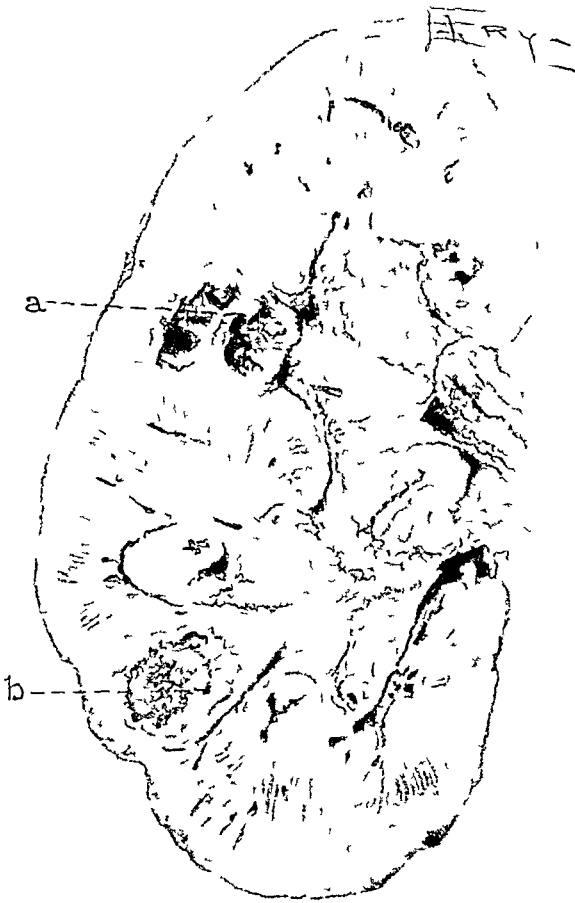


FIG 3—Small early tuberculous lesion limited to several papillae

case, pre-operative surgical procedure may cause such extensive perinephritic adhesions that it is impossible to avoid opening the abdominal or pleural cavity.

Perinephritic Inflammation—This is not an uncommon complication in cases of tuberculous kidney, and greatly increases the danger of primary lumbar nephrectomy. The risk is apparently greater when the peritoneal cavity is opened although extensive soiling may occur without causing trouble.

In eight cases of our series perinephritic abscesses were drained, and secondary nephrectomy was performed. In most cases, the kidney with extensive perinephritic infection is of the completely destroyed, occluded type for which subcapsular nephrectomy is necessary. Good results are generally

obtained One of the eight patients died two years after nephrectomy, the others are alive and well After incision of a perinephritic abscess, the fistula generally persists until a second nephrectomy is performed In an occasional case, the condition of the patient may prohibit an extensive primary operative procedure, necessitating a two-stage operation

The high, early and late mortality in association with perinephritic abscess is in part, owing to the fact that tuberculous infection is generally of many years' duration, as evidenced by the extensive destruction of the kidney The opposite kidney may reveal toxic nephritis, and the general resistance of the patient is much below that of patients with only a moderately extensive unilateral infection

In a second group of eight cases in the series, the perinephritic abscess was incised and nephrectomy performed at the same time Two patients died several days after operation, one two years, and one six years afterward The other four are living and well on an average of four years after the operation Contamination of the peritoneal cavity is apparently more serious following

nephrectomy than following simple drainage of the abscess The greater area exposed to trauma and absorption reduces the general resistance of the patient to infection

Bilateral Infection As a rule, renal tuberculosis is primarily unilateral Delay in removing the infected kidney unquestionably increases the risk of infection in the opposite kidney Israel found an extension to the opposite kidney in twenty-nine of 100 non-operated cases On the other hand, in only thirteen (16 per cent) of 1022 cases of nephrectomy for tuberculosis was there tuberculous infection in the remaining kidney Kummell found eighty-one bilateral infections in 119 necropsies for renal tuberculosis, in only five of 100 surgical cases was the infection bilateral

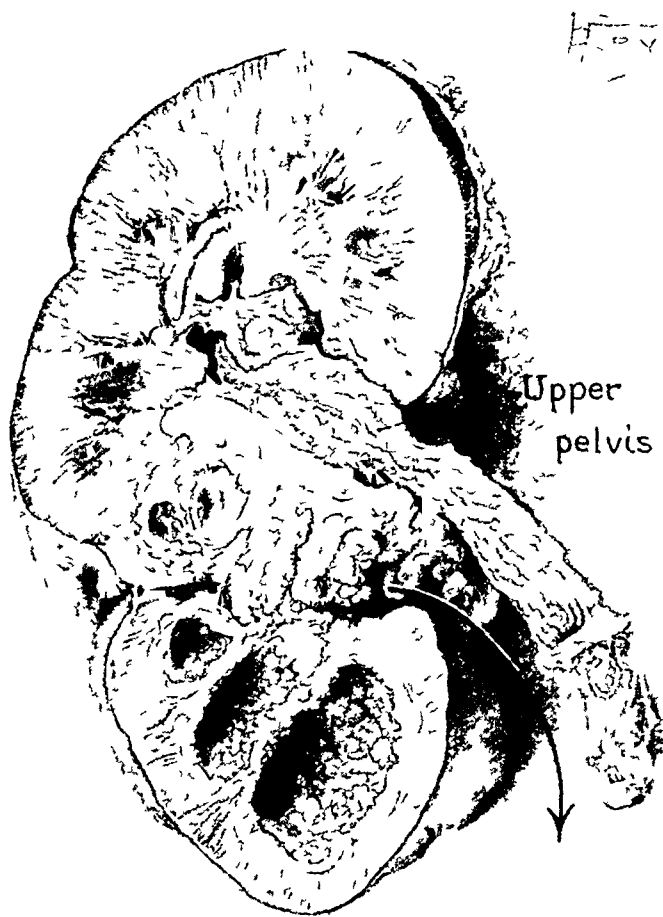


FIG 4 —Caseation and infection confined to lower pole and simulating a double kidney

The removal of one kidney in a case of bilateral infection is essentially a palliative procedure Wildbolz asserts that there is no definite indication that it will cure even the smallest lesion in the opposite kidney Rochet and Thevenot reported fourteen cases of nephrectomy for bilateral infection In eleven, the infection in one kidney was slight, the kidney removed was extensively diseased One patient died from uræmia two weeks after operation,

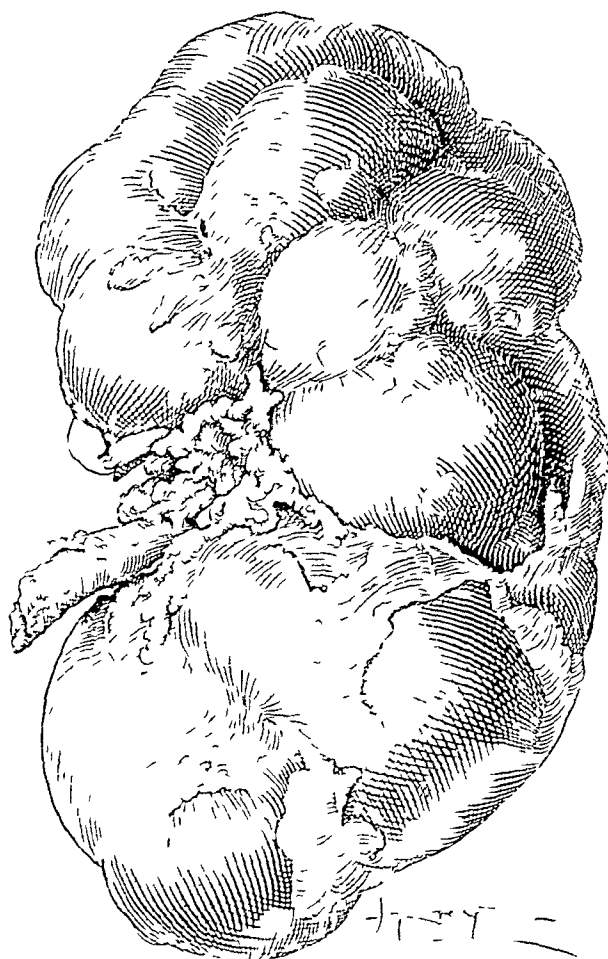


FIG. 5.—Soft fibrous sac of almost completely destroyed kidney.
The ureter is stiff and thickened

four died later Six lived, three of whom were in apparently good health Three patients with severe infection of both kidneys, died promptly after the removal of one kidney In certain cases of bilateral infection, removal of the more extensively diseased kidney apparently influences the remaining kidney favorably, and may unquestionably improve the patient's condition Legueu collected ninety-three cases in which nephrectomy had been performed for bilateral infection Thirteen patients died immediately after operation, most of them from anuria Thirty died during the first three years after operation Twenty-two were alive, seven one year, fourteen from two to five years, and one eight years after operation In all, there was apparently bilateral infection, but the diagnosis of tuberculous disease in the remaining kidney may be questionable On the other hand, there are undoubtedly many cases believed to be unilateral in which there is infection in the opposite kidney, even though there may be no signs of inflammatory reaction in the urine from that kidney Braasch⁵ has recently shown by guinea-pig inoculation, that in seven of twenty-two cases apparently unilateral, there was infection on the opposite side Following removal of the obviously diseased kidney, these patients all have evidence of active urinary tuberculosis

In our series there were eighteen cases of bilateral infection in which the

SURGERY OF RENAL TUBERCULOSIS

more extensively diseased kidney was removed. Four patients died of anuria immediately after the operation, and ten died during the next eighteen months, in most instances either from renal insufficiency or from other tuberculous foci.

Type of Lesion There are various types of renal tuberculosis that are important to the surgeon. The lesion may be small, it may be limited to the tips of several papillæ and the adjoining mucosa, or to several well isolated areas in the renal parenchyma (Figs 3 and 4). On external examination and palpation, the kidneys sometimes appear normal. If the pelvis is involved, as is often the case, the ureter is enlarged, thickened and hardened. In an



FIG 6 —Extensive tuberculosis of the kidney with caseation and destruction of the kidney

occasional case, if the lesion is small, isolated, and well surrounded by fibrous tissue, the ureter may be normal and there may be no confirming data of tuberculous infection from an examination of the kidney. In such a case, the data from an accurate cystoscopic examination is more reliable than surgical palpation.

In the majority of cases treated surgically, the pelvis and ureter are extensively involved, there are numerous areas of caseation in the kidney, and sometimes areas of fibrosis and soft necrosis (Figs 5 and 6). The surface of the kidney is studded with groups of small tubercles, and the perinephritic fat is œdematous and adherent to the kidney (Fig 7). In cases of long-standing, the kidneys may be almost completely destroyed and

smaller than normal, the pelves moderately dilated, and the renal parenchyma thin and sac-like. Enough urinary secretion persists to keep the bladder constantly infected. Occasionally in this type of case, one portion of the kidney may contain a large walled-off abscess which is readily ruptured on surgical manipulation.

With stricture and obstruction of the ureter, complete destruction of the kidney occurs. In such cases the obstruction has been gradual and of long duration. The mass is composed of a fibrous shell of the kidney containing

caseating material. In some instances, calcareous deposits (Fig 8) are sufficiently extensive to cast a complete roentgenographic shadow of the kidney. When there is complete occlusion of the ureter, the inflammation of the bladder subsides in most cases. Following obstruction, the retained infected urine and pus may rupture through the renal capsule into the surrounding tissues, or may break through into the peritoneal cavity. In most cases old

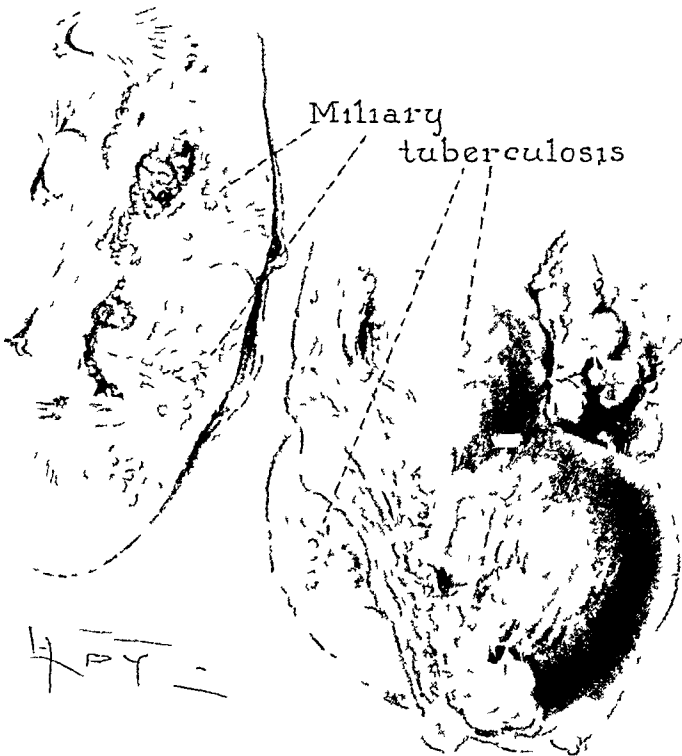


FIG 7—Miliary tuberculosis with only moderate involvement of the kidney

occluded tuberculous kidneys are surrounded by only slight perirenal reaction, they may be removed readily and the wound closed without drainage. In thirty-four of thirty-nine cases of this type, the wound was closed without drainage and healed by first intention, in the remaining five, drainage continued for a short time. In many such cases there is no active tuberculous infection. Braasch,² in an endeavor to determine whether active tuberculosis bacilli were present, injected an emulsion from five such kidneys into guinea-pigs. In four cases, the guinea-pigs remained normal, the fifth died of diffuse tuberculosis.

In cases in which there is sudden complete obstruction of the ureter early in the course of the disease, acute, generally markedly infected, hydronephrosis may occur. Such sacs may become very large, containing from four to five litres of fluid in some instances. They may become adherent to the diaphragm

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and peritoneum, and often are associated with extensive perinephritis. Like the completely destroyed kidneys, these hydronephrotic tumors may also rupture into the surrounding tissues, and it may be impossible to remove the kidney and capsule intact. In other cases, removal of the large dilated kid-



FIG 8—Fibrous shell of tuberculous kidney completely filled with caseating material undergoing calcareous degeneration

ney, its capsule, and the adherent perirenal fat would expose a very extensive area for infection and absorption. In cases of this type, a subcapsular nephrectomy may be safer than complete removal of the kidney and perirenal tissues.

Post-operative Course The mortality following nephrectomy was high

in earlier cases Schmieden reported a mortality of 25.4 per cent in 106 cases between 1890 and 1900. Kuster (1902) found a total mortality of 18.8 per cent in 297 collected cases. In recent large series of cases the percentages are much lower, Boeckel reports 5.8 per cent and Legueu and Chevassu 5.9 per cent. Israel, in a collected review of 1023 nephrectomies, found an operative mortality of 12.9 per cent, and a late mortality of from 10 to 15 per cent. Wildbolz asserts that the larger collected general reviews are not of as much value as the more carefully compiled statistics of individual surgeons. From the reports from several large urologic centres he collected 1450 cases with a mortality of 5 per cent. Only eleven (2.4 per cent) of 445 of Wildbolz' own patients died following operations. Most of the deaths were due to heart or lung complications. Sixty-two per cent of 317 patients, operated on at least one year before were cured, 30 per cent were dead, and 8 per cent still had evidence of disease. Fifty-five per cent of 104 patients operated on at least ten years before were completely cured, forty-four died of tuberculosis mainly of the genito-urinary tract. In Kummell's 188 cases, there was a mortality of 7 per cent, of the remaining 176, sixteen patients died the first year, and fourteen in the next four years. Thirty-nine patients were well from fifteen to twenty years after operation, and thirty-eight from ten to fifteen years.

Three hundred and fifty-eight (58.6 per cent) of the 611 patients in the Mayo Clinic on whom complete post-operative data were obtainable, are cured on an average of four years after operation, 191 (31.2 per cent) are dead. Sixty-two (10.1 per cent) still have evidence of tuberculosis of the genito-urinary tract. The patients still having trouble are mostly those who have been operated on recently. Persistence of discomfort of the bladder and tuberculous foci in other parts of the body, account for many of the persistent symptoms.

Operative Deaths—Twenty-three of the 119 patients who died following nephrectomy for unilateral tuberculosis, died during the first month after operation. This number represented 2.7 per cent of 845 nephrectomies. In the early cases, uræmia was one of the most common causes of death, and accounted for the large operative mortality. In many of the cases, it was the result of infection in the opposite kidney. With our present accuracy in pre-operative diagnosis, uræmia only rarely causes death. Only one of 175 patients on whom nephrectomy was performed, reported by Wildbolz, died of uræmia. Israel found that most of the early deaths in his reported cases were due to cardiac failure or to acute miliary tuberculosis.

Early Mortality—Five patients in our series died after operation from uræmia. In most cases, death was due to a non-tuberculous infection of the opposite kidney, or to chronic nephritis. There were five deaths from peritonitis, in all instances the peritoneum was adherent to the kidney and opened during the course of the operation. In three cases, pulmonary complications, pneumonia, empyema, and pulmonary embolism, respectively, caused death. One patient died from general septicæmia, and one from paralytic ileus.

SURGERY OF RENAL TUBERCULOSIS

Wildbolz cited a case similar to this in which paralytic ileus occurred following nephrectomy, the peritoneal cavity was not opened. One patient died from post-operative hemorrhage on the fifth day. At necropsy, general miliary tuberculosis was found. In two cases the cause of death was not determined. In two cases operations had been performed elsewhere in an attempt to remove the kidney, in a third a perinephritic abscess had been drained. In one, death occurred the second day from tuberculosis of the adrenal, and in one case a tuberculous kidney had ruptured into the chest before operation. In one, death was due to thrombosis of the vena cava.

Late Mortality Israel believes that the chief causes of late post-operative death are pulmonary tuberculosis and tuberculous infection of the opposite kidney. He found, in a series of cases, that more than one-half of all late deaths occurred within two years after nephrectomy. Pulmonary tuberculosis was the cause of death in 45 per cent, tuberculosis of the kidney in 35.9 per cent, and acute miliary tuberculosis in 14 per cent. He also believes that 73 per cent of all pulmonary tuberculosis causing death existed before operation. Of the late deaths, due to renal insufficiency, 69.5 per cent were caused by renal tuberculosis, in 30.5 per cent there was no tuberculosis. He reports several cases in which the patient survived the operation more than nine years, then died of a tuberculous infection in the opposite kidney.

Forty-two (25.6 per cent) of 164 subsequent deaths occurred in the first year, eighty-three (50.6 per cent) from the second to the fifth year, and twenty-one (12.8 per cent) from the sixth to the tenth year. In eighteen the date of death was not known. Thirty-one died from infection of the remaining kidney, which was tuberculous in fifteen.

Meningitis is often the cause of late deaths. Simmonds found at necropsy that 30 per cent of men with genito-urinary tuberculosis had died from meningitis, and only 5 per cent from pulmonary tuberculosis, none from infection of the genito-urinary tract.

There were five late deaths due to meningitis. In the cases in which extensive local infection of the wound, general miliary tuberculosis, or extension to the meninges develop, the kidneys are not infrequently of the acute, septic, hydronephrotic type.

Twenty-one patients died of general miliary tuberculosis, and twelve of pulmonary tuberculosis. Three died of tuberculosis peritonitis. The remainder died from causes other than tuberculosis.

SUMMARY

Eight hundred seventy-four patients with renal tuberculosis were treated surgically. Nephrectomy was performed on 863 and an exploratory operation only, on nine. Complete post-operative data were obtainable concerning 611 patients. Usually complete lumbar nephrectomy was performed. In a few instances, transperitoneal nephrectomy was performed or the peritoneal cavity was opened while the kidney was being removed by the lumbar route, such contamination of the peritoneal cavity markedly increases the operative risk.

In the presence of a perinephritic abscess, removal of the kidney and drainage of the abscess at the same time increases the operative risk. Two of eight patients died following such procedures. None of the eight patients died on whom the two-stage operation was performed.

In eighteen cases of bilateral infection one kidney was removed. Four patients died from anuria immediately after the operation, and ten died during the next eighteen months.

Twenty-three patients (27 per cent of 845 who had had unilateral nephrectomy) died the first month after operation. One hundred ninety-one (31.2 per cent of the 611 patients) are dead, 358 (58.6 per cent) are completely cured on an average of four years after operation, and sixty-two (10.1 per cent) are still having urinary trouble.

BIBLIOGRAPHY

- ¹ Boeckel, A. M. C. *Valeur de la nephrectomie dans la tuberculose renal*. Nancy, 1912, 765 pp.
- ² Braasch, W. F. *Occluded Renal Tuberculosis*. Jour Am Med Assn, 1920, vol lxxv, pp 1307-1309.
- ³ Braasch, W. F. *Surgical Renal Tuberculosis The Prognosis*. Am Jour Med Sc, 1920, vol clxx, pp 8-19.
- ⁴ Braasch, W. F., and Scholl, A. J. *Pathological Complications with Duplication of the Renal Pelvis and Ureter (Double Kidney)*. Surg, Gynec and Obst, 1922, vol xxxv, pp 401-417.
- ⁵ Braasch, W. F., and Scholl, A. J. *Possible Errors in the Diagnosis of Renal Tuberculosis*. Jour Am Med Assn (In press).
- ⁶ Dickinson. Quoted by Vignard and Thevenot.
Hansen, P. N. [Die Aetiologie und Pathogenese der chronischen Nierentuberkulose]. Nord med Arkiv, 1904, vol xxxv-xxxvi. Abstr. Zentralbl f Chir, 1904, vol xxxi, pp 889-890.
- ⁷ Israel, J. *Die Endresultate der Nephrektomien bei Nierentuberkulose*. Folia Urol, 1911, vol vi, pp 257-286.
- ⁸ Judd, E. S. *Surgery of the Kidney*. Minn Med, 1920, vol iii, pp 221-227.
- ⁹ Kocher, T. *Chirurgische Operationslehre*. 5 Aufl. Jena Fischer, 1907, 1096 pp.
- ¹⁰ Kornfeld, F. *Ueber Nierentuberkulose*. Wien klin Wchnschr, 1908, vol xxi, pp 1231-1238.
- ¹¹ Kimmell, H. *Ueber Nierentuberkulose*. Ztschr f Urol, 1923, Beiheft, pp 18-28.
- ¹² Kuster, E. *Die Chirurgie der Nieren*. Deutsche Chirurgie. Stuttgart, Enke, 1896-1902, 52 b, 721 pp.
- ¹³ Legueu, F. *The Question of Nephrectomy in the Presence of Bilateral Tuberculosis*. Urol and Cutan Rev, 1917, vol xxi, pp 620-626.
- ¹⁴ Legueu and Chevassu. *Traitement de la tuberculose urinaire*. Gaz d prat, 1912, vol xiv, pp 257-266.
- ¹⁵ Mayo, J. *Nephrectomy without Drainage for Tuberculous Kidney*. Surg, Gynec and Obst, 1912, vol xv, pp 523-524.
- ¹⁶ Pousson. Quoted by Frank, K. *Ueber Nierentuberkulose*. Centralbl f d Grenzgeb d Med u Chir, 1911, vol xiv, p 264.
- ¹⁷ Rochet, V., and Thevenot, L. *Tuberculose renale bilaterale et nephrectomie*. Lyon chir, 1912, vol vii, pp 509-524.
- ¹⁸ Schlesinger, Elisabeth. *Beitrag zur Kenntnis der Nierentuberkulose*. Bern Drechsel, 1913, 25 pp.

SURGERY OF RENAL TUBERCULOSIS

- ²⁰ Schmieden, V Die Erfolge der Nierenchirurgie Deutsch Ztschr f Chir , 1902, vol lxii, pp 205-312
- ²¹ Simmonds, M Ueber Tuberculose des mannlichen Genitalapparats Deutsch Arch f klin Med , 1885-1886, vol xxxviii, pp 571-586
- ²² Vignard, P, and Thevenot, L La tuberculose renale chez l'enfant Jour de'Urol , 1912, vol 1, pp 323-344
- ²³ Walters, W Surgical Treatment of the Ureter in Tuberculosis of the Kidney Minnesota Medicine, 1923, vol vi, pp 307-308
- ²⁴ Wildholz, H Chirurgie der Nierentuberkulose Neue Deutsch Chirurgie Stuttgart, Enke, 1913, vol vi, 194 pp
- ²⁵ Wildholz Ueber die Dauererfolge der Nephrektomie wegen Nierentuberkulose Ztschr f Urol Chir , 1921, vol viii, pp 17-20
- ²⁶ Zuckerkindl, O Die geschlossene Bedeutung fur Klinik der Nierentuberkulose Wien med Wchnschr , 1908, vol lviii, pp 129-132

PILONIDAL SINUS *
(COCCYGEAL FISTULA)
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THE lesion known in American literature as pilonidal sinus, and on the Continent, chiefly by the name of coccygeal fistula, may not fairly be considered of major surgical importance, nor is it of sufficient rarity to cause interest as a surgical curiosity. It does, however, deserve attention because of the frequent mistakes made in its diagnosis, the confusion with fistula in ano, and the various explanations of its etiology. Moreover, very little reference to the subject is to be found in the literature. Less than a dozen original articles have been found in a fairly extensive search covering the past sixty years, and the standard texts on general surgery carry little or no reference to the subject. Even the special volumes on rectal surgery are notably lacking in discussion of it. It has therefore seemed worth while to present the salient facts in regard to pilonidal sinus, with a collection of a number of cases.

The lesion presents itself, in its uncomplicated form, as a small orifice—3 to 5 mm in diameter—in or near the posterior midline of the body, at about the level of the sacro-coccygeal joint. The orifice is round or oval and its edges are smooth, skin covered, and free from granulations. Occasionally a small tuft of hair projects from the opening. A probe passed into the orifice finds a sinus tract usually passing upwards toward the sacrum for a variable distance, in most cases only 1 to 2 cm, but occasionally 5 to 6 cm. This tract, when studied histologically, is found lined with epithelium. Often there is a mat of loose hair lying in the sinus. The sinus ends blindly, perhaps in a sacculated pouch, and does not communicate with any other structure. In those cases that have become infected the picture is modified by inflammatory signs, swelling, tenderness, etc., along the course of the sinus, perhaps the discharge of pus through the orifice, and particularly by the development of adventitious orifices in the neighborhood, usually to one or other side of the midline, also discharging pus. These differ from the original orifice in being ordinary fistulous openings, lined by granulations, and with an ulcerated ragged orifice.

The first record of this lesion that I have been able to discover is that of J M Warren,¹ 1867, who clearly presents two cases, and remarks that he has nowhere seen a description of such a lesion, although he thinks he has encountered personally eight or ten instances. Only one was in a woman, of dark and hairy type. The others were in hairy men. He notes the tendency to confusion with fistula in ano and states that the sinus should be dissected out. Warren advances the rather imaginative theory that the cause of the trouble is a reversed hair-follicle, and that the turned-in hair, as it continues to grow, "pulls its hole in after it," as it were.

* Read before the Southern Surgical Association, December 11, 1923

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In 1880, Hodges² refers to Warren's description, which he states is the only reference he can find in the literature, and he describes the lesion, but makes the error of stating that the sinus has no lining membrane except ordinary granulation tissue. He could find only one case in the female in the records of the Massachusetts General Hospital, the case of Warren's. Hodges gave the name of pilonidal sinus to the lesion—a nest of hair—and believed the hair was the cause of its development. He thought short, loose hairs from the surface, in people of unclean habits, accumulated in a post-anal dimple, excoriated the skin, and worked their way into the deeper tissues, causing a sinus. In the same volume Hodges and Post report other cases.

Mason,³ also in 1880, reports a case in a woman.

In 1883, Couraud⁴ in a French thesis, discusses at length the questions of post-anal dimple, pilonidal sinus and post-sacral dermoid. He gives credit to Warren as first describing the lesion here discussed and covers the other bibliography of the related subjects. He thinks the dimples, sinuses, and dermoids are various degrees of the same process and quotes various views as to its etiology. Two of these have already been mentioned. Kuhn (quoted) considers these lesions remaining traces of hydrorachis or spina bifida. Lawson Tait (quoted) regards the dimples as defects due to the evolutionary disappearance of a caudal appendage. Fere (quoted) thinks a failure of the two halves of the body to unite properly behind is the explanation. The writer then reports three cases of his own and Schwartz and quotes several others from the literature.

In 1885, Wendelstadt,⁵ in a Bonn thesis, reports three cases, and again reviews the literature, which is not appreciably fuller than in Couraud's thesis. He thinks the loose hair plugging the orifice of the fistula is often the cause of retention and infection. Points out confusion of this lesion with fistula in ano and osteomyelitis of sacrum or coccyx. He advises surgical removal of the sinus tract, and advises against treatment with chemical injections. He advances the following idea of the etiology. The inferior end of the spinal cord is the last portion to lose its connection with the skin. As the sacrum closes together and pinches off this connection, the skin becomes attached by fibrous tissue at this point to the posterior surface of the sacrum. As adult life approaches, fat and soft parts grow and lift the skin farther away from the bone. The attached spot is thus drawn down into a dimple or sinus.

Hermann and Toureux,⁶ 1887, after discussion of the theories above mentioned, direct attention to the embryology of the posterior end of the neural axis. They show that after the separation of the spinal cord from the superficial tissues a process of epithelial tubules persists for a time at the point of previous connection of the neural axis with the skin, forming a vestigial remnant of that connection. To this remnant, which normally completely disappears, they attribute the formation of pilonidal sinus, when atrophy fails to take place.

E. J. Beall,⁷ in 1889, reported five cases of what he calls coccygeal dermoid, all in male patients, and points out that they are commonly not correctly diagnosed, but are mistaken for ordinary abscesses, caries of the coccyx or sacrum, or for fistula in ano. He believes them to be more frequent than the literature indicates, and advises thorough surgical removal of all the abnormal tissue.

Graham,⁸ 1897, credits Hodges with first correctly describing and naming this lesion. He also states that he could find only two references to the lesion in surgical works, once as a lesion of the spine, and once as a disease of the rectum. Distinguishes between the small, deep pit of pilonidal sinus and the broad, shallow depression known as post-anal dimple. He reports one case.

It will be seen that the references herewith quoted, which cover all the direct consideration of this subject in original articles that were found, are few in number, present in all a very few cases, and are vague on such matters as the histology of the lesion and its etiology. They are all clear and definite.

on the clinical picture presented, and on the proper treatment complete surgical removal

The writer has collected the cases on record at the Johns Hopkins Hospital, for which permission he is deeply indebted to Doctor Finney, and has added his own private cases thereto. These have been studied particularly with the following points in mind: Age, sex, and race of patients, previous operations, and histological study. In the Johns Hopkins Hospital records forty cases were found. In addition, the writer has seen twenty-one cases, making a total of sixty-one cases in all. Every one of these patients was white, in spite of the fact that Baltimore has a large negro population, and the hospital has always had an active colored service, no case in the negro has been seen. Only ten of the sixty-one cases were females, 16 per cent. Two patients were forty-nine years old when operated on, the most advanced age in the series, three were eighteen, the youngest recorded. The average reduced age—that is, the age of admission less the number of years the lesion had been observed—for the whole series is twenty and one-half years. Clearly the condition although congenital, first gives trouble in early adult life. Twenty-five, or nearly half of this series, had been operated upon, in some manner, at least once previously, and one history bears the note “eight or ten previous operations”—a point to be referred to later. One case also presented a bifid uvula and hypospadias. Among my own cases is an interesting group, a father and two sons all of whom were operated upon at different periods for pilonidal sinus. These cases and the age of incidence throw light upon the congenital character of the lesion. Many of these patients had suffered recurring trouble with the sinus for a long period of time, in several instances for more than ten years, and in two for over twenty years.

The writer was fortunate enough to discover and remove cleanly, a typical sinus which had never been actively inflamed. This he believes to be good practice, but incidentally it afforded material for histological study much better than is usually obtained from acutely infected sinuses. The specimen was dissected out whole at operation, and blocked and sectioned thus, without opening it. The lumen of the sinus contained hairs. The inner portion of the wall was of many layers of stratified cuboidal epithelium with only slight cornification adjacent to the lumen, but with imperfect and rudimentary papillæ in certain areas. Hair follicles were seen and also sweat glands. Outside of the epithelial layer was a dense corium-like sheath, and beyond this loose fat and areolar tissue. Some of the sweat glands lie in the fat at quite a distance from the lumen of the sinus. In short the sinus is a slightly modified invagination of true skin. None of its elements were fully developed even the characteristic hair is thin, fine and scanty in pigment, somewhat like lanugo.

In reviewing the literature above, the various theories of origin of these little sinuses were outlined. None of them seemed quite clear. In an effort

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to understand better the character of this lesion, evidently congenital and of embryonic development, recourse was had to Dr George L Streeter of the Department of Embryology, Carnegie Institute of Washington, Baltimore, Maryland. Doctor Streeter was good enough to place the rich material of his department at my disposal, and aid me with his even more valuable advice. In spite of these advantages, no satisfactory explanation of the problem has yet been found. It is true that for a time a small cystic remnant of the lowermost portion of the medullary groove persists and is known as the "coccygeal medullary vestige." This is lined by a single layer of columnar cells and is doubtless the structure to which Hermann and Toureux have referred. Normally, this little cystic structure has no opening communicating with the skin, and ultimately disappears. Furthermore, its cells are similar in appearance to those lining the central canal of the spinal cord, and in Doctor Streeter's opinion have already become so differentiated that they could not be expected later to give rise to skin, even though the cystic remnant should persist. It is Doctor Streeter's view that pilonidal sinus must be regarded as a special local down-growth of epithelium, originating from the true skin and not from the medullary groove. The skin in certain regions forms organs like the breast, and the external ear, by just such an invagination. No suggestion is as yet advanced as to why such an invagination takes place occasionally in the coccygeal region. In short, beyond the feeling that the skin and not the neural groove is the source of the sinus no facts are present to explain the origin of the lesion.

Personal experience with these cases, a review of hospital records, and a survey of the literature have all led to certain clear-cut ideas as to the clinical aspects of this interesting lesion.

First, as to diagnosis. To one who has ever knowingly seen a pilonidal sinus, there can be no difficulty. To those who have not chanced to see a case the following points should immediately suggest the diagnosis. Its situation, over the coccygeal region, well posterior to the anus, the midline or nearly midline orifice, with its smoothly rounded edge, and with or without a tiny protrusion of hair from its lumen. If there is no active inflammation, a cord-like structure can often be felt running upward and backward a short distance from the orifice. As a rule there is inflammation, as that is the reason for seeking medical aid. Here one must be on guard against mistaking the lesion for fistula-in-ano or disease of the underlying bones. The long history so often obtained may misleadingly suggest these possibilities. A probe passed into the sinus should throw much light on the question. Instead of going toward the anal canal, as in fistula, it passes upward and backward away from it. The bare bone of osteomyelitis also is, of course, not to be felt. Confusion may be caused by incidental inflammatory orifices of secondary origin, but the original orifice is characteristic and should be sought for.

The diagnosis once established, the problem of treatment is easily solved. It consists in the complete excision of the whole tract with its entire wall.

The area excised should be wide enough to include the sweat glands in the tissue removed. Anything less is unsatisfactory. Yet our experience and that of others shows that all too commonly incision and drainage or palliatives, such as poulticing, may be employed. No case can be considered permanently cured until the sinus wall is removed. As long as any of it remains, recurrence of inflammation may be looked for. Cases seen before infection has occurred should be excised, as such wounds may be closed cleanly, the operation is short and easy, and the probability of later infection through the open orifice, is thus avoided. This is not meddlesome surgery, but sound prophylactic surgery. When first seen *after* infection has occurred, drainage following excision is usually necessary and sometimes this wound takes a surprising time to heal. The location of the lesion is such that healing by granulation progresses slowly. Non-surgical treatment is usually a waste of time.

SUMMARY

Pilonidal sinus is a congenital defect. It occurs principally in males, and has not been described except in the white race. It is not rare. It may be familial in incidence and associated with other anomalies of development.

The diagnosis is made from its position and the appearance of its orifice.

The treatment is complete surgical excision.

BIBLIOGRAPHY

- ¹ Warren, J. M. Surgical Observations, 8° Boston, 1867, p. 192.
- ² Hodges. Boston M. and S. Jour., 1880, vol. ciii, pp. 485, 493 and 544.
- ³ Mason. Med. Rec. N. Y., 1880, vol. xvii, pp. 524.
- ⁴ Couraud, J. Contribution à l'étude des dépressions, fistules, etc., de la région sacro-coccygienne, 4° Paris, 1883.
- ⁵ Wendelstadt, H. Ueber Hauteinstülpungen und haarhaltige Fisteln in der Sacro-coccygeal Gegend, Bonn, 1885.
- ⁶ Hermann and Toureux. Comp. rend. Acad. des Sc., Paris, 1887, vol. civ, p. 1324.
- ⁷ Beall, E. J. Trans. South. Surgical and Gyn. Assn., 1888, Birmingham, Ala., 1889, vol. 1, pp. 79-85.
- ⁸ Graham, D. W. J. A. M. A., Chi., 1897, p. 115.

COMPLETE OUTWARD DISLOCATION OF THE PATELLA*

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EXPOSED as the patella is to all sorts of trauma, it is singularly free from dislocation. Dennis¹ says Dislocation of the patella occasionally occurs and forms about 1 per cent of all dislocations. Stimson² writes Dislocations of the patella are rare, less than 1 per cent of all dislocations, and the infrequency with which they have come under the observation of individual surgeons and the incompleteness or the obscurity of the reports of many cases have combined to make the systematic descriptions rather artificial and unsatisfactory. Eisendrath³ announces About 200 cases of dislocation of the patella have been reported. Astley Ashhurst⁴ states It is also seen very occasionally as a traumatic lesion. As recently as 1922, when discussing this question, Dennis Crile⁵ said Dislocations of the patella are rare and the patient is not usually seen while the dislocation persists. Spontaneous reduction or reduction by the patient or a friend is usually accomplished before the surgeon arrives. In view of its acknowledged rarity, I believe, that the following case of complete outward displacement of the patella is of sufficient interest to justify its presentation.

Report of Case—Miss L., white, female, school-teacher, aged nineteen, on September 8, 1923, sustained an injury to her left knee by stumbling over a suit-case. She endeavored to regain her balance, but failed, and fell to the floor, where I found her a half hour later. She was in great pain and resented any attempt to change her position as the slightest movement of the injured limb increased her suffering. The knee was not swollen, but was slightly flexed, broader than normal, and visibly misshapen. Beyond the inferior articular surface of the femur and resting against the outside of the external condyle was a bony mass which touch and sight identified as the patella. Its anterior surface was palpable throughout and looked outward. The inner margin of the knee-cap was directed forward, its outer border was turned backward, and its articular surface was in contact with the external condyle. The patella was fixed. The leg was flexed on the thigh. The knee-joint was stiff and immobile. The site of the intercondylar notch was indicated by a crease in the overlying skin. Both condyles could be felt. The tendon of the quadriceps extensor muscle and the ligamentum patellæ were tautly contracted and stood out like whipcords. The clinical evidence was so frank as to leave no doubt as to the nature of the injury, *viz*, a complete outward dislocation of the patella, which was in the absence of any visible evidence of trauma attributed to muscular violence. An X-ray examination was not obtained because of (1) the obviousness of the diagnosis, (2) the urgent insistence of the patient for relief from her suffering. The replacement of the bone was therefore undertaken without anaesthesia and much to my relief easily accomplished. The thigh was flexed on the pelvis, the leg extended and pressure exerted on the outer border of the patella. Almost immediately the bone flew back into place with an audible snap. Instantly the young lady expressed herself as free from pain. As a safeguard against the recurrence

* Read before the Southern Surgical Association, December 13, 1923.

of the dislocation a plaster-of-Paris case was applied from the ankle to the groin. This was removed two weeks afterwards and the girl allowed to get about on crutches. She has now regained the full use of her leg and reports herself as completely cured.

Dislocation of the patella is almost always outward. The injury may follow a blow upon the inner margin of the patella, but fully as often results from a sudden, violent muscular contraction, especially if the knee is flexed and turned inwards as in catching one's self while falling. According as the patella is still in contact with the trochlea or lies upon the epicondyle, the luxation is classed as incomplete or complete. Both forms occur with about equal frequency. When the dislocation is complete the patella may assume any one of three positions. Its articular surface may face the condyle with its external border behind and its inner in front, or the inner margin of the patella may impinge against the external condyle with its anterior surface looking directly forward, the knee-cap having undergone no rotation, or the inner margin of the patella may dip backward with its anterior surface in contact with the external condyle and with its outer border pointing forward. In the incomplete type of outward dislocation, the patella does not entirely leave its articulation with the femur, but is merely carried more or less to the outer side. Generally its inner border is caught in the intercondyloid notch and the outer half of the patella overhangs the external condyle where it presents as a prominent swelling on the outer side of the knee with its anterior surface looking obliquely inward and backward as the result of a partial rotation. The strong leaning of the patella toward the outward variety of displacement is not a matter of chance. The conformation of the knee-joint and the muscles attached to the patella enter largely into the choice. The external condylar ridge is considerably less prominent than that of the internal condyle and the pull of the quadriceps is upward and in a direction parallel to the long axis of the femur. Since the femur and the tibia join each other at an obtuse angle with the apex directed inwards and the ligamentum patellæ lies in the long axis of the tibia, the quadriceps when it contracts not only pulls the patella upward but also exerts considerable outward traction on this bone. To counterbalance this tendency, nature has supplied man with a strong internal lateral ligament and has scooped out the lower end of the femur in such wise as to tightly engage the irregularly wedge-shaped posterior surface of the patella when the knee is extended and the thigh muscles contracted. Notwithstanding the excellent protection thus afforded against dislocation by this arrangement, a violent contraction of the quadriceps or a blow upon its inner margin may suffice to dislocate the patella, especially if the ligaments are relaxed and the lip of the external condyle is underdeveloped.

The symptoms are characteristic. The slightly bent leg is held stiff and immobile, for fear of exciting pain. The knee-joint is broader than normal and there is a visible as well as a palpable prominence on its outer side. The condyles can be felt and the trochlea is indicated by a groove in the overlying skin. The extensor tendon and the ligamentum patellæ are tautly contracted.

An X-ray examination will verify the diagnosis. After reduction there is no great tendency to recurrence of the luxation. According to v Bergmann,⁶ even if the dislocation persists, the use of the limb is gradually recovered and hard work is possible, but extension is limited and the genu-valgum becomes more pronounced.

In recent cases a closed reduction with or without anæsthesia is generally feasible. When such efforts fail an open replacement must be made. This can be done either by a straight or a curved incision. Habitual luxation has been cured by non-operative treatment, but usually requires an operation. Bajardi has accomplished a cure by cutting out of the inner side of the capsule an oval slice of redundant tissue and suturing the margin of the defect, thus created, together. Le Dentu has obtained satisfactory results by reefing the relaxed capsule. Albee⁷ splits up the front of the condyle and elevates the fragment until a wedge-shaped hiatus is formed into which he inserts a chunk of bone cut from the tibia, holding the graft in place with a pin. In some instances it has been found necessary to chisel off the tubercle of the tibia and transplant it inwards. Whilst the methods enumerated above, either alone or in combination generally suffice to effect a cure, on occasion some more complicated technic needs be exploited. Whenever a rent is found in the capsular ligament, be it in a fresh dislocation or in a recurrent displacement, the hole must be sewn, regardless of what else is done.

REFERENCES

- ¹ Dennis. Dennis, System of Surgery. Lea Brothers and Co., Philadelphia, 1895, vol. 1, p. 635.
- ² Stimson. Stimson, A Practical Treatise on Fractures and Dislocations. Lea Brothers and Co., New York and Philadelphia, 1905, 4th edition, p. 789.
- ³ Eisendrath. Keen's Surgery. W. B. Saunders Company, Philadelphia and London, 1911, vol. 11, p. 426.
- ⁴ Ashhurst. Ashhurst, Surgery, Its Principles and Practice. Lea and Febiger, Philadelphia and New York, 1920, 2nd edition, p. 448.
- ⁵ Crile. Ochsner, Surgical Diagnosis and Treatment. Lea and Febiger, Philadelphia and New York, 1922, vol. 14, p. 302.
- ⁶ v Bergmann. v Bergmann, A System of Practical Surgery, translated by Bull. Lea Brothers and Company, New York and Philadelphia, 1904, vol. 111, p. 589.
- ⁷ Albee. Warbasse, Surgical Treatment. W. B. Saunders Company, Philadelphia and London, 1920, vol. 1, p. 787.

PRIMARY PERITONITIS *

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THE early literature of peritonitis is of interest more from an historical standpoint than a scientific one, inasmuch as it was only with the recognition of the true nature of pus that it became a pathologic entity. From this, to modern times, peritonitis existed in two forms, known and unknown, and the latter, if anything, more numerous than the former.

In 1880 Grawitz¹ essayed to refine this classification and divided the disease into primary and secondary groups, including in the first what he termed rheumatic or idiopathic forms, and in the second, those of known origin in the abdominal viscera.

Upon this ground work Tavel and Lanz,² in 1893, published their classification which substituted "chemical" for "idiopathic" and multiplied the phases of the secondary forms.

All this, while it dignified and amplified the previous conception did not materially alter it.

Consequently, with a more rational method in view, Flexner³ published in 1898 his work on the etiology and classification of peritonitis. In this he recognized two great divisions, primary and secondary, stating that, "By primary peritonitis is understood a condition in which an inflammation of the serous cavity arises without the mediation of any of its contained organs and independent of any surgery upon these parts."

The term primary peritonitis is in a way a misnomer, for in our contact with neoplastic diseases we have come to consider a primary lesion as the initial site of the disease process. In fact, to the clinician, "primary" possesses an absolute value rather than a purely relative one. Thus, an otitis media may be the primary body lesion and eventuate as a blood-borne peritonitis which in turn, as regards peritoneum and viscera, is an essentially primary disease.

With this understanding of "primary" we can group under this heading the "essential" peritonitis of Duparque, the "rheumatic" of Grawitz, the "chemical" of Tavel and Lanz, the "pneumococcic" of Bozzolo⁴ and the idiopathic of the host of other writers on the subject.

Previous to 1860, although many cases were reported as idiopathic, or (as we would consider them) primary, the data is unconvincing and inadequate. Perhaps the first really plausible case record was that made by Behier and Hardy⁵ in 1864, while Duparque in 1867, presented a more complete report which is identified as a "pneumococcic" peritonitis.

* Read before the Minnesota Pathological Society, October 16, 1923

Hertzler⁶ credits Bigelow⁷ as reporting the first satisfactory case in American literature in 1872

From this time to the present date the literature of the subject has consisted mainly in reports of scattered cases. Of the more pretentious articles are those of Michaut,⁸ Annand and Bowen⁹ and Von Brunn¹⁰ on pneumococcus peritonitis, the earlier reports of Flexner and Manahan,¹¹ together with the more recent ones of Fishbein,¹² Rabinowitz¹³ and Melchoir,¹⁴ on primary peritonitis other than the pneumococcic

Despite the large amount of reported material the disease possessed a questionable status up to very recently. In a measure this may have been due to the recognition of appendicitis and the subsequent vogue of appendectomy. From the belief that some peritonitides were at least inexplicable, the profession generally assumed that any peritonitis of undemonstrable origin was due to appendicitis and looked with disfavor and suspicion upon any surgeon who failed to substantiate this opinion.

Moreover, Nothnagel,¹⁵ in 1901, emphatically denied the possibility of a primary peritonitis, and Armstrong¹⁶ insisted in the face of some biologic difficulties that all primary peritonitis was essentially an infection of the Fallopian tubes. The observations of Jensen¹⁷ working on animals and those of Dieulafoy,¹⁸ Weichselbaum,¹⁹ Lennander and Nystrom²⁰ appeared to strengthen Nothnagel's contention.

However, Kunzel,²¹ in 1904, presented a definite case of peritonitis in which he had made most elaborate and detailed gross, microscopic and bacteriologic examinations and in which he was able to establish its identity as a blood-borne infection from the naso-pharynx.

The later reports of Chapelle,²² who exhaustively studied the sore throat epidemic in Helsingfors and the observations of Fishbein, Rabinowitz, Ruppanner²³ and others serve to strengthen this position to a degree that primary peritonitis in the sense of Flexner's classification must be accepted as a definite hæmatogenous disease process.

From the autopsy records of the Pathological Department at the University of Minnesota, through the courtesy of Dr. E. T. Bell, I have been able to collect twenty-eight such cases. In the majority of instances I have been able to supplement them with their respective hospital charts which makes available a moderate amount of clinical data. As it would be a footless undertaking and only lead to confusion to enumerate these severally, I have attempted to summarize the findings under a relatively few important headings.

These I have arranged in tabular form, as follows.

The difficulty in establishing a distinct syndrome which might be of diagnostic value is at once made manifest by the shortness of the series, although from even this inconsiderable number some conclusions may be drawn. Apparently there is no sex predilection and the age incidence is so variable as to be of little import.

Of the ten cases in which there was no known origin or accompanying disease elsewhere in the body, five had pain and vomiting at the onset while the remainder had neither pain nor vomiting

In the eighteen cases accompanied or preceded by other sites of infection only four noted pain as an abdominal symptom and only five vomited

In the tabulation of results, the temperature record is of necessity inadequate as it is not possible to present the daily range and progress and only the consistently high readings have been recorded Examination of the available hospital records in all instances shows an early rise with a rapid development of the septic curve The few instances of low temperature occurred in adults with no accompanying disease and who reached a fatal termination in very few days

Leucocytosis is an almost invariable finding, the one exception being a leucopenia in influenza The total counts observed show an average mean around 20,000, although in two instances they amount to 40,000 The differential count exhibits little of significance, the P M N forms usually being increased to eighty per cent or more

In contrast to the majority of observers, but in accord with Rabinowitz, diarrhoea was found to be an infrequent occurrence, being noted in only three instances

The foregoing summarizes briefly the phase of onset As the condition develops two features become almost constantly in evidence, *viz*, distention and fluid

In twenty of the twenty-eight cases the records give marked abdominal distention as the chief terminal symptom and the autopsy findings note the presence of fluid in relatively large amounts Whether this is always in a clinically demonstrable amount, particularly in infants, it is difficult to say, but from the appended clinical notes it appears readily recognized in children and adults

The prognosis in this type of peritonitis is always gloomy, but perhaps not so entirely hopeless as a casual observation of the statistics suggests It is undeniable that in the twenty-two unoperated cases the mortality was one hundred per cent, which allows little to be hoped for from expectant treatment, but of the six which were treated surgically, two survived operation This of course is in itself inconclusive, but at least it emphasizes the possibility of a lower mortality at the hands of the surgeon

The autopsy findings as a whole agree with the reports published elsewhere, except as to the type of invading organism In the face of the many reported cases of pneumococcus peritonitis the occurrence of but one case in the series is surprising, although the absence of bacteriologic studies in nine instances may be sufficient explanation

As to the nature of the peritoneal content, little can be said to amplify what has been expressed in the table In most instances it was frankly purulent in character and profuse in amount

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	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	TOTAL
MALE	+	+	+	+	+	+	+	+			+	+																	11
FEMALE							+		+	+	+		+	+	+	+		+	+		+		+	+	+	+	+	+	17
AGE	25	44	2m	3m	3m	46	30	11w	8w	13	6w	6w	9	28	62	9	50	52	8m	5m	16m	50	6w	66	28	7w	58	10w	
DISEASE	INFU	0	ENVIR	PNEUM	RHINI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
OPERATION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	
LIVE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	
DIE	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	26	
DURATION	1	5	?	?	?	6	5	?	3	?	7	2	7	8	10	4	5	1	3	7	2	8	4	1	7	7	?	1	17
PAIN	+	0	0	?	?	0	+	0	+	?	0	?	0	0	0	+	+	+	0	?	?	+	?	0	0	0	+	0	10
RIGIDITY	0	+	+	?	?	0	0	0	?	0	?	0	0	0	0	+	0	?	?	?	+	+	?	0	0	0	0	5	
DISTENTION	0	+	0	?	?	+	+	+	+	?	+	?	+	+	+	0	+	0	+	+	+	+	+	?	+	0	+	+	20
EMESIS	0	0	0	?	?	+	+	0	+	?	?	0	0	0	0	+	+	+	0	+	+	+	+	0	0	0	0	10	
DIARRHOEA	+	0	0	?	?	0	0	0	?	0	+	0	0	0	0	0	0	0	0	0	0	0	?	0	0	0	+	0	3
TEMPERATURE	105	99	104	?	105	100	100	100	103	104	105	103	102	103	100	?	?	105	?	105	104	104	?	102	104	103	104	103	
LEUCOCYTES	41000	9000	?	?	21000	11000	22000	?	?	24000	?	18000	12000	40000	21000	24000	?	22000	?	8000	35000	?	?	?	18000	?	3000	?	
FLUID	200	400	250	100	75	100	75	250	30	400	50	150	1000	1500	300	150	800	30	100	100	500	100	100	200	25	200	50	40	
CLEAR																												1	
PURULENT	+	+	+	+	+	+				+		+	+	+	+	+				+	+	+	+	+	+	+	+	+	17
TURBID							+	+	+	+	+						+	+	+										10
ORGANISM	STREP	?	STREP	PNEUM	STREP	?	?	STREP	STREP	STREP	STREP	STREP	STREP	STREP	0	STREP	STREP	?	BACILL	?	?	STREP	?	STREPT	?	?	STREP	B. COLI	STREP

One case, however, is worthy of note in that it coincides with what Melchior has recently reported as acute primary serous peritonitis

As it has been more or less obscured in the tabulated findings, a very brief summary is necessary for identification

An unmarried woman of twenty-eight with a history of tonsillitis terminating ten days previously was suddenly seized with chills, fever and indefinite abdominal distress Twenty-four hours later she appeared extremely toxic with a temperature of 103 and 40,000 leucocytes The abdomen was distended and there was demonstrable fluid As the cardiorenal function was not impaired this was thought to be exudate At operation the peritoneum and viscera were negative on careful examination, but 1500 c c of clear sterile fluid was drained from the abdomen Recovery was uneventful

In conclusion there are a few statements based upon these observations which at least appear to be justifiable

The acute fulminating forms of primary peritonitis can rarely be diagnosed until in a terminal stage, while the more slowly developing cases incidental to disease elsewhere should be more frequently recognized Also in the presence of infectious diseases or signs of sepsis a distended abdomen, particularly one with demonstrable fluid, should be strongly suggestive of peritonitis

As to the treatment there is little choice I have operated on four cases and two have survived, and I am naturally inclined to this course in the face of the one hundred per cent mortality from other methods

Certainly Murphy's dictum that expectant treatment in appendicitis was expectans mortem, is equally true here

BIBLIOGRAPHY

- ¹Grawitz Statistischer und experimentell pathologischer Beitrag zur Kenntnis der Peritonitis Charite-Ann, vol xi, p 770, 1884.
- ²Tavel and Lanz Ueber die Ätiologie der Peritonitis Mitt aus Klin u Med Inst der Schweiz, 1893
- ³Flexner The Etiology and the Classification of Peritonitis Phil Med Jour, vol ii, p 1019, 1898
- ⁴Bozzolo Ueber eine Form durch Kapselkokken verursachter multipler Serositis Cent fur Klin Med, vol vi, p 177, 1885
- ⁵Behier and Hardy Traite elementaire de pathologie interne Paris Labe, vol iii, p 543, 1864
- ⁶Hertzler The Peritoneum C V Mosby Co, St Louis, 1919
- ⁷Bigelow Rheumatic Peritonitis Phil Med Times, vol iii, p 554, 1872
- ⁸Michaut Contribution a l'etude de la peritonite a pneumococques chez l'enfant These de Paris, 1901
- ⁹Annand and Bowen Pneumococcic Peritonitis in Children Lancet, vol i, p 1591, 1906
- ¹⁰Von Brum Die Pneumokokken Peritonitis Beitr z klin Chir, vol xxxix, p 57 1903
- ¹¹Manahan The Bacteriology of General Peritonitis Boston M and S J, vol clii p 346, 1905
- ¹²Fishbein A Contribution to the Bacteriology of Peritonitis, with Special Reference to Primary Peritonitis Am J M Sc, vol cxlv, p 502, 1912

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- ¹³ Rabinowitz Acute Hæmatogenous Streptococcic Peritonitis Am J M Sc, vol cli, p 797, 1919
- ¹⁴ Melchoir Zur Kenntnis der Peritonitis Serosa acuta Klin Wchnschr, vol 1, p 1089, 1922
- ¹⁵ Nothnagel Ueber idiopathische Peritonitis Wien klin Rundschau, vol xvi, p 401, 1901
- ¹⁶ Armstrong Peritonitis of Unknown Origin Montreal M J, vol xxxii, p 728, 1903
- ¹⁷ Jensen Ueber Pneumokokken peritonitis Arch f klin Chir, vol lxi, p 1134, 1903
- ¹⁸ Dieulafoy Peritonitis à pneumococques Clin Med Del Hotel Dieu, vol 1, p 396, 1897
- ¹⁹ Weichselbaum Ueber seltenere Lokalisationen des pneumonischen Virus Wien klin Wchnschr, vol 1, p 596, 1888
- ²⁰ Lennander and Nystrom Quoted by Hertzler, p 614
- ²¹ Kunzel Eiterige Peritonitis im anschlusse an akute Tonsillitis Munchen med Wchnschr, vol li, p 752, 1904
- ²² Chappelle Quoted by Rabinowitz, p 800
- ²³ Ruppanner Ueber metastatische Streptokokken Peritonitis Schweiz med Wchnschr, vol lvi, p 610, 1922

RECENT CONTROVERSIAL QUESTIONS IN GALL-BLADDER SURGERY*

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IN a number of papers on the surgery of the gall-bladder written during the last two or three years, certain assumptions regarding etiology, symptomatology and morbid anatomy are frequently made. It is taken for granted that the removal of the gall-bladder is not accompanied by any untoward after results and that, the gall-bladder once removed, there is no likelihood of reinfection of the common duct or the formation of stones. It is assumed that there is a causative sequence in certain lesions, chronic appendicitis being followed by hepatitis, hepatitis by cholecystitis. The infected gall-bladder is considered a focus from which infection is carried through the lymphatics to the liver and pancreas. The formation of stones is said to be but a symptom of the disease and to have little significance in the course of the disease or the spread of the infection. Cholecystitis is said to be a disease of youth. Marked morbid changes in the gall-bladder and cholelithiasis of the middle-aged, it is asserted, have been preceded by masked attacks of cholecystitis. It is assumed that there are no latent gall-stones or cholecystitis and that careful inquiry will always elicit symptoms of very mild attacks of epigastric pain, eructation of gas, pyrosis, abdominal distention, inability to eat certain foods, etc., that by the recognition of these mild cases and by the performance of cholecystectomy in the young people of to-day the patients with advanced lesions of the biliary tract twenty years from now will be eliminated. Not only are mild attacks of cholecystitis said to give symptoms, but the hepatitis accompanying it is supposed to cause autointoxication and recurrent bilious attacks and these again are cured by removal of the gall-bladder.

In a word, it is taken for granted that a patient is spared years of ill health by removing a slightly infected gall-bladder and that changes in the wall of the gall-bladder, so slight that they can only be detected by histological examination, furnish a focus from which infection spreads to neighboring organs and justify a cholecystectomy.

I have thought it might be of interest to study these assumptions, to weigh the evidence as we have it for and against accepting them.

The material I have used for analysis and review consists of two hundred and twenty-nine cases of cholecystectomy for cholecystitis, in which the lesion was confined to the gall-bladder, and thirty-eight cases in which there was a complicating choledochitis or cholangitis, done by the surgical staff at St Luke's Hospital during the last two years, the Follow-up report on three hundred and twenty-one patients on whom operations had been performed.

* Read before the New York Surgical Society, December 12, 1923

either on the gall-bladder or the common duct, and the autopsy records where lesions of the biliary tract are recorded

The first cholecystectomy was done by Langenbuch, July 15, 1882¹ Since then thousands of gall-bladders have been removed There has been ample time and abundant opportunity to study the disturbance of function and alteration of structure caused by its removal The subject has been studied experimentally for a much longer period Zambecari began these investigations by removing the gall-bladder in an animal over two hundred and fifty years ago, and it was well established when Langenbuch removed the gall-bladder that its absence in animals was not accompanied by any serious disturbance The attempt has been made to draw conclusions from comparative anatomy and from rare instances of congenital absence of the gall-bladder Much of the experimental work has been repeated with conflicting results and the exact functions of the gall-bladder are still in doubt However, there is a general agreement among physiologists that gall-bladder bile is more concentrated than hepatic bile and that the gall-bladder acts as a current regulator for the flow of bile into the duodenum, that is to say, the presence of the gall-bladder does modify the bile and does influence its rate of flow into the duodenum² After the gall-bladder is removed, since the liver secretes bile continuously, the bile must pass into the duodenum as soon as the distention of the common duct exerts sufficient pressure to overcome the sphincter of Oddi, and in animals the common duct and hepatic ducts have often been found dilated up to the point where they emerge from the liver after the removal of the gall-bladder In many instances this dilatation is accompanied in time by a loss of tone in the sphincter muscle placed about the termination of the common duct and the flow of bile is continuous into the duodenum³

There is no more curious chapter in comparative anatomy than the one that records the vagaries of this diverticulum of the excretory duct of the liver, for as a diverticulum, not as a bladder, it must be considered from the point of view of development The gall-bladder is not present in the horse, ass, zebra, tapir, rhinosceros or the elephant It is absent in the true deer but present in the closely related musk deer Owen found a large gall-bladder, bifid at the fundus, in a female giraffe In two males subsequently dissected there was not a vestige of gall-bladder The hog has a gall-bladder while its New World relative, the peccary, has it not⁴ I shall not attempt to follow the presence or absence of the gall-bladder in the various vertebrate orders except to call attention to the fact that its absence is not noted in carnivora where food is taken at long intervals, but is noted in the vegetarian mammals in which digestion is carried on nearly continuously without marked interruption Its congenital absence in man is rare I give an instance taken from our autopsy records

The child, one year old, was normally developed and well nourished and had had an uneventful history with no record of illness until four days before her admission, when she had an attack of diarrhœa The symptoms improved, but after a week in the hospital

she died rather suddenly. At autopsy it was decided that death was due to a small patch of bronchopneumonia and to an exudation of pus in the left pleura. This was small in quantity but widely distributed over the entire pleural surface. On lifting up the liver not a trace of gall-bladder could be seen nor any evidence of previous inflammation. The *common duct* was *not* dilated, the papilla of Vater was normal in size and position. The hepatic ducts were somewhat anomalous as there were two small ducts from the right lobe which joined the common trunk below the three which proceeded from the left lobe. The hepatic artery and portal vein were normal. There was a slight groove in the liver marking the right margin of the quadrate lobe. The pancreas was normal. Other deformities or abnormalities were not found⁵.

For a number of years observations have been recorded which seem to show a diminution in the acid reaction of the gastric contents after the removal of the gall-bladder or after morbid changes which destroy its function as a bile reservoir,⁶ and several observers have mentioned a slight transitory diarrhoea in which there are several stools passed made up entirely of bile, but the wonderful power of adaptation possessed by the body seems to mask or compensate for changes in function which its removal causes and the symptoms that patients suffer after cholecystectomy are apparently not due to changes in functions, the result of the absence of the gall-bladder.

In recent papers, however, there are rather widespread acknowledgments of occasional difficulties, dependent not on functional derangement due to the absence of the gall-bladder, but incidental to its removal. Not only have there been papers on reconstruction of the common duct, many of them due to injury done during cholecystectomy, but there have also been a number of papers dealing with the anomalies and variations in the arrangements of the cystic duct, cystic artery, hepatic artery and common duct.⁷ Some of these have been frankly prompted by a narrow escape from injury to the duct. In several instances actual injuries have been reported by operators of wide experience, nor have the injuries been confined to operations performed for far advanced lesions, but have occurred when doing a simple cholecystectomy. There have also appeared, since cholecystectomy became so frequent, a number of papers urging the closing of the abdominal incision without drainage, the reason being given that adhesions were avoided, a confession that post-operative adhesions have been a real source of trouble.⁸

In our Follow-up results we have found eighty-four per cent of patients after cholecystectomy free from all symptoms. We have asked them especially concerning epigastric pain, indigestion, vomiting and loss in weight. Of the sixteen per cent giving symptoms, over half complain of more or less epigastric pain and discomfort in the neighborhood of the scar. This pain varies from slight discomfort to a very real disturbance and is at times accompanied by a feeling of distention. Gastric symptoms, distention, inability to eat certain food, nausea and vomiting are by no means infrequent, symptoms so similar to those given as characteristic of gall-bladder disease that it is difficult not to assign them to some other cause than infection of the gall-bladder wall. In several instances there has been pronounced inter-

ference with normal emptying of the stomach. Nor relation between the severity of the lesion in the gall gastric symptoms, nor has the attempt to close the abdomen avoided this difficulty. There is much evidence that now from the cystic duct, even after it has been carefully closed. We have closed the abdomen after cholecystectomy with five times. In one patient, on the twelfth day, without pro there was the discharge of a considerable collection of bile, evidently been slowly leaking, had been shut in by adhesions escaped externally. In another case closed without drainage made a good recovery and went home. In a few months pronounced gastric symptoms. X-ray examination showed retention after a barium meal. At operation no lesion of stomach, but dense adhesions bound the stomach and duct kinking and obstructing the pylorus. Doctor Downes, who tells me he has rarely encountered in a gall-bladder case made. He attributed the condition to the irritation of the peritoneum of bile, certainly absence of drainage had not prevented a

A few years ago there was much discussion as to whether or cholecystostomy gave fewer adhesions. I think it was that there were more after the drainage than after the removal of the bladder. Extensive adhesions do occasionally occur, giving symptoms, after even simple cholecystectomy and cholecystostomy.

In thirteen per cent of those that had post-operative have been attacks of jaundice, vomiting and signs of infection. That is, in two per cent of the patients on whom a cholecystectomy there was evidence of interference with the flow of bile through the duct. In this group, three, or a little less than one per cent for operation for stones in the common duct.

The question of the formation of these stones in the common duct has been much discussed. In the majority of patients the symptoms soon to suggest their formation in the common duct. When an impacting stone in the common duct be removed, it is often of being made up of a nucleus looking like an old gall stone with laminated new deposits. Behind the impacting stone, numerous small stones frequently form in the common and hepatic ducts. In our series no instance in which we could not explain the presence of stones overlooked at the time the cholecystectomy was performed. Stones occur in the common duct that give no symptoms and are not answered. Kehr⁹ makes the rather astonishing statement that in cholecystectomies he has found stones in the common duct in 10 of his cases in which there was not the slightest sign of the disease, jaundice nor intermittent temperature. Moynihan¹⁰ reports in a hundred where stones were found in the common duct. Certainly small stones in the common duct are frequently

cholecystectomies and most of the recurrences are due to this cause. Even when there are unmistakable symptoms of stone in the duct they are overlooked. Kehr ¹⁰ states that he counts on overlooking one in about two per cent of his cases. This admission from an operator of wide experience who had almost an obsession regarding the drainage and exploration of the common duct is significant.

In this connection there is an interesting point in comparative pathology. Horses have no gall-bladder, yet occasionally they die of infective cholangitis and impacted stones in the common duct. I quote from an autopsy report ¹¹

"On incising the right lobe of the liver a yellowish, penetrating, stinking fluid escaped. The gall-duct was greatly thickened. In the left lobe the gall-ducts were much dilated and their walls three-quarters cm thick. Little gall-stones were found throughout these ducts to the number of several hundred. In the chief exit there was a yellowish stone as big as a pigeon's egg. Its long diameter measured four cm."

Some years ago I remember reading the notes of an autopsy on an elephant. The animal had died of a common duct stone. I cannot now find this reference, but in Quinke's ¹² monograph on diseases of the liver he writes of the occurrence of gall-stones in animals that have no gall-bladder, for example, the elephant.

I repeat the points which I wish to emphasize. Although patients after cholecystectomy maintain excellent nutrition and are free from symptoms, adhesions often follow the removal of the gall-bladder. These adhesions occasionally derange the normal operations of the pylorus and duodenum, causing pain and vomiting. Injury to the common duct has occurred often enough to suggest that the operation of cholecystectomy has at times considerable technical difficulties.

Stones which give no symptoms of their presence or give symptoms that are overlooked are not infrequently left in the common duct when the gall-bladder is removed for cholecystitis with cholelithiasis, especially in long-standing lesions. Stones very rarely form in the common duct after the gall-bladder is removed. Secondary stones frequently form in the common duct and hepatic ducts when a gall-bladder stone has become lodged in the common duct. These are reasons offered against removing the gall-bladder for slight lesions and in favor of removing all gall-bladders when stones are present or there is a well-recognized lesion.

In 1915, C. H. Mayo ¹³ reported that fifty-three per cent of the patients on whom cholecystostomy had been done for cholecystitis were without symptoms. All had been observed for more than a year. Recently Cullen ¹⁴ has reported the results in two hundred and ten patients on whom cholecystectomy had been done for cholecystitis. Many of them had been observed over a period of years. One hundred and sixty-eight were well and free from all symptoms. It is fair to say that if there had been an infection in the wall of the gall-bladder or an infection of the pancreas and liver, it had subsided with drainage, without the removal of the infected gall-bladder wall. Cullen, however, writes "In 1915, I had my own gall-bladder drained

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after the removal of a large number of stones, later on more stones formed and the gall-bladder was excised" Some years ago I was acting as assistant in a hospital where the Senior Surgeon did not believe in cholecystectomy. Several times I removed gall-bladders after a cholecystostomy had failed to cure the patient. I gained the impression that a patient with cholecystitis and cholelithiasis would recover if the stones were removed and the gall-bladder drained, provided the cystic duct was not blocked. It was the uncertainty of the patency of the cystic duct, the inability to be sure that all the stones were removed, the recurrence of infection and formation of new stones if there was stagnation of bile, that made cholecystectomy preferable to cholecystostomy, although at that time, fourteen years ago, cholecystostomy was the operation of choice in many of the larger hospitals. The infected gall-bladder wall in these drained cases remained, undoubtedly containing many bacteria. Many of the patients gave evidence of infection of the common duct with the well-recognized symptoms in the liver and pancreas. But if there were no infection in the common duct, they did not develop pancreatitis or hepatitis recognizable clinically, nor was there persistent infection of the common duct unless there was a stone there or obstruction. It was recognized then, as now, that if the occlusion in the common duct was intermittent, infection almost certainly occurred. It was also recognized if the obstruction in the common duct was removed and drainage established that the infection frequently subsided and did not recur.

Two years ago Graham¹⁵ read a paper on "Observations on the Pathogenesis of Infection of the Biliary Tract." His views have been widely accepted. He points out that there are numerous lymphatic vessels passing from the gall-bladder to the liver, that in the infected gall-bladder the maximum reaction to infection is found in the deeper layers of the gall-bladder wall, that there is hepatitis present in most infections of the gall-bladder and that the cholecystitis is usually secondary to hepatitis. In a patient on whom he was operating for appendicitis he removed a specimen from the liver and found hepatitis present. He refers to a widely accepted view that there is a close etiological relation between appendicitis and cholecystitis. He believes that from the appendix usually, or from some other portion of the portal system, bacteria enter the portal vein, are carried to the liver, lodge there, set up a hepatitis of sufficient severity to infect the lymphatics that pass from the liver to the gall-bladder and that thus the wall of the gall-bladder is infected, that the infection subsides in the liver but the liver soon becomes reinfected from bacteria that are growing in the wall of the gall-bladder and that pass again through the same lymphatics to the liver substance.

Now it has long been recognized that there are numerous lymphatics passing between the liver and the gall-bladder. They are admirably shown in *Sappey's Atlas*, published in 1874. His plates have been widely copied in text-books of anatomy. That in certain infections (appendicitis, infected

thrombosed piles, infection of the umbilical vein in infants) a progressive septic thrombophlebitis occasionally is set up and that numbers of bacteria pass to the liver in the portal blood and that lesions of all degrees of severity occur and that in some instances the infections may pass to the wall of the gall-bladder, is well known I give the details of a case taken from a recent autopsy record

"A child, ten years old, very ill, was admitted to the hospital She had a high temperature, tenderness and an indistinct feeling of mass in the right hypochondrium The abdomen was opened, the liver was found enlarged, the gall-bladder seemed acutely inflamed It was removed The patient died in three days At autopsy there was only a small amount of serous fluid in the upper part of the abdomen There were no signs of peritonitis The liver was enlarged and riddled with abscesses There was an early parietal clot forming in the portal veins Section of the gall-bladder removed at operation showed a subacute cholecystitis Although the liver was filled with abscesses, some of them but a few centimetres from the gall-bladder, only enough infection had passed through the lymphatics to set up a subacute lesion Cultures from the pus in the abscesses showed colon bacilli"

If infection of the gall-bladder has persisted there is usually an infiltration in the cellular tissue about the gall-bladder In chronic cases it is often necessary to sever by sharp dissection this dense cellular plane and to dissect out the gall-bladder from it If the manipulations are at all rough the gall-bladder and adherent cellular tissues tear away the friable underlying liver substance This is the layer in which are situated most of the lymphatics Chills, fever and signs of general infection are not common in uncomplicated suppurative inflammation of the gall-bladder Liver abscess occasionally occurs, but only where the gall-bladder has ruptured into the liver substance We have frequently been impressed with the lack of relation in the morbid anatomy and the clinical signs in these patients The lymphatics seem largely obliterated and blocked

During the course of acute appendicitis, cholecystitis and hepatitis are not usually recognized The associated acute lesions occur, but they are not common Wharton¹⁶ reported such a case in 1909 A boy, aged thirteen, was operated on for a gangrenous appendicitis Subsequently he was operated on again for intra-abdominal abscesses, and on the twenty-second day two hundred c c of pus was evacuated from an acutely inflamed and distended gall-bladder No stones were found

I do not find in patients operated on for acute suppurative appendicitis any disproportionate number later developing chronic cholecystitis Nor do the autopsy records on patients dying of acute appendicitis as a rule show lesions of the liver Tens of thousands of microorganisms are undoubtedly lodged in the liver, just as they are in the spleen and the bone-marrow in general sepsis from acute appendicitis They are taken out of circulation and many of them are destroyed in these situations

In the experiments that Graham details to prove the sequence of lesions—portal infection, hepatitis, cholecystitis—he injected four to six c c of twenty-four-hour broth cultures of staphylococcus aureus into the portal veins Such massive contamination of the portal blood is only comparable to acute infec-

tions as seen clinically No one seems much concerned, however, with the association of the acute appendicitis and cholecystitis It is chronic appendicitis that is in question, all cases being so grouped in which there is evidence of antecedent inflammation, whether these acute lesions have been completely cicatrized or not, whether the interval since the acute lesion has been months or years and whether the acute or subacute phase has been of very slight extent and of very short duration This association of chronic appendicitis with cholecystitis and duodenal ulcer was advanced and supported by the work of MacCarty¹⁷ at the Mayo Clinic in 1910 and is based on examination of a very large number of appendices (5584) removed at operation He writes "Examination of the appendices removed in association with 'pyloric spasm,' gastric and duodenal ulcers, cholecystitis and cholelithiasis, shows that there is a higher percentage of appendices with partially or completely obliterated lumina in all of these conditions than at general autopsy or at operation for appendicitis" I give our own findings in Table IV It is based on too small a number of cases to be of much value That statistical information of this sort is misleading is notorious How the bacteria pass from one of these chronic lesions into the portal circulation neither MacCarty nor Graham states

In 1917, Rosenow¹⁸ extended his interesting theory of specific strains of microorganisms with special elective affinity for certain tissue to include this group He believes that the microorganisms are carried by the blood stream He writes "Appendicitis, ulcer of the stomach and duodenum and cholecystitis are largely embolic infections from some distant focus of infection or even from the more or less normal intestinal tract, by streptococci or other bacteria having elective affinity for these structures and the presence of two or more of these diseases in the same individual is in the beginning due more often to this cause and not so often to infection by continuity or by the way of the lymphatics" His views do not suggest a causative sequence but a common cause for the associated lesions Unfortunately other observers have not been able to confirm his claim Zinsser,¹⁹ in his text-book of bacteriology, definitely states that he does not believe it He writes "It is an interesting thought, yet a dangerous one to spread broadcast, since it has influenced clinical thinking to an extent not warranted by experimental fact" Rosenow, in the course of his experimental work, found a striking difference in the character of the lesions following injection of streptococci and colon bacilli When streptococci were introduced the lesions were largely in the muscular coat and serosa of the gall-bladder When colon bacilli were introduced the mucous membrane was often necrotic and sloughing and the peritoneal and muscular coats but slightly involved

Possibly the organisms enter the portal circulation by the process spoken of by Adam²⁰ as sub-infection Phagocytes about any focal infection are constantly taking up bacteria and are then finding their way back, through the endothelium of the capillaries, into the circulating blood Adam believes that

many are carried into the portal circulation from the intestinal mucosa even when there is no lesion, but a superficial catarrh of sufficient severity to make a slight cellular exudate. He believes he has evidence that these organisms are being constantly destroyed by the liver cells and that, under certain conditions, they may set up low grades of hepatitis and chronic nephritis. There is no proof that the hepatitis, that Graham and others who have confirmed his views have found, is not some such condition. The whole subject of hepatitis and cirrhosis is considered by pathologists, I think, an uncommonly difficult one. It is certainly difficult to discuss clinically when the same term is used for a very slight infiltration of the liver substance by polymorphonuclear leucocytes, suppurative hepatitis and terminal stages of liver cirrhosis following the destruction of the hepatic cells by various toxins and their replacement by connective tissue.

About a gall-bladder, extending beneath the serosa, and especially between the liver and the gall-bladder, is a layer of cellular tissue in which are situated lymph capillaries communicating with the lymphatics of the liver and in which are embodied the collecting lymphatic vessels which pass to glands situated at the neck of the gall-bladder and at the pancreatic-duodenal junction. This cellular plane is continuous with that covering the pancreas. As Huxley²¹ so well expressed it many years ago "So completely and thoroughly does the connective tissue permeate almost all parts of the body that, if every other tissue could be dissected away, a complete model of all the organs would be left composed of this tissue." Whenever infection takes place it is infiltrated and much swollen and the zone of swelling extends from the focus according to the severity of the infection and the reaction of the tissues. This is as true for an infected gall-bladder as an infected finger. In acutely infected gall-bladders the cellular tissue between the gall-bladder and the liver is succulent and swollen and there is infiltration of the contiguous portions of the liver. There is frequently present swelling and infiltration about the neck of gall-bladder and the pancreas. But there are usually no clinical signs, after the removal of an infected gall-bladder or even its drainage, of persistent pancreatitis or hepatitis. There is usually prompt recovery. A conspicuous feature in many cases is the rapid gain in weight and the excellent nutrition of these patients, conditions hardly compatible with persistent pancreatitis or hepatitis. And as Judd²² writes in a recent article "Even if there is much pus in the gall-bladder, or it has become gangrenous, severe infection is unusual in the pancreas." Acute pancreatitis, to be sure, is given as the cause of death determined by autopsy in a case reported by Whipple²³ when the lesion was confined to the gall-bladder wall, but this seems an exceptional finding. The mortality is low in infections of the gall-bladder uncomplicated by infection of the common duct and bile passages. In Whipple's series of one hundred and seventy-five cases it was less than one per cent. In the series reported in this paper it is over one per cent (17 per cent). There were eleven deaths in eight hundred and

ninety cholecystectomies recently reported from the Mayo Clinic (12 per cent) ²⁴

If, however, there is even slight obstruction to the common duct, and especially if this obstruction is intermittent, infection of the common duct regularly follows and the infection soon travels to the bile capillaries and a hepatitis is present. The anatomical relation of the pancreatic and the common bile duct is such that no matter what the arrangement of the two ducts, whether they are double-barrelled and open separately into the duodenum, whether they open into a common ampulla or whether there is an accessory duct, it is difficult to think of much swelling or occlusion in the transduodenal portion of the common duct without the pancreatic duct being compromised. I am not referring to the possible backing up of bile in the pancreatic duct by a stone in the terminal portion of the common duct, apparently an uncommon occurrence, but to the possibility of intermittent occlusion of the pancreatic duct and the phenomena of infection in glandular tissue which would be expected to follow, for the readiness with which all glandular tissue becomes infected when there is intermittent occlusion is well recognized. The kidney, the salivary glands, the lactating mammary glands and the liver, all furnish examples. Whipple reported eighteen cases in which he had noted a curious condition which he described as pancreatic asthenia, six were carcinomata and of the remaining twelve, six had at operation a stone in the common duct. Sistrunk,²⁵ two years ago, reported four cases of stone in the pancreatic duct. In one there were at the time of operation stones in the common duct. He attributes their formation to stagnation of secretion and infection.

There is evidence then, from autopsy findings, that marked suppurative lesions of the liver, from infection carried by the portal vein, are accompanied by moderate infection of the gall-bladder wall. There is evidence that suggests marked chronic suppurative inflammation of the gall-bladder is often associated with blockage of the lymphatics and but slight infection of the neighboring portion of the liver. There is very slight evidence that microorganisms pass into the portal circulation from an obliterated appendix in sufficient quantities to set up any of the clinical forms of hepatitis or cholecystitis. It has long been known that there are frequently low-grade infections or sub-infections of the liver. It has been suggested that leucocytes, at times containing attenuated microorganisms pass into the portal circulation through the intact mucous membrane of the bowel or through small lesions and set up these sub-infections. There is some evidence of such sub-infection of the gall-bladder wall. The clinical forms of pancreatitis and hepatitis are well known to be frequently associated with infection of the common duct. These are very infrequent when the infection is confined to the gall-bladder wall.

It has been said that if one makes careful inquiry in patients in whom gall-stones are discovered during the course of a laparotomy for some other condition there is nearly always a past history of epigastric pain or the

symptoms of a special form of indigestion which is associated with cholecystitis and cholelithiasis ²⁶ These symptoms are eructation of gas, a feeling of distention, discomfort and pain on eating certain foods, a condition often spoken of as "qualitative food dyspepsia" However, they have been found conspicuously absent in several instances where I have left a gall-bladder in place in which stones had been distinctly palpated during the operation for fibromyoma of the uterus Moreover, there are no inconsiderable number of patients in whom a first attack of typical biliary colic is not preceded by any symptoms and this is occasionally true between the attacks They are conspicuously well nourished with hearty appetites and contented countenances I have one such case under observation at present The patient, a man forty years old, had had two typical attacks of biliary colic At operation he had chronic cholecystitis, numerous small stones in the gall-bladder and one in the common duct The lesion gave evidence of long standing The most careful questioning failed to draw out a single gastric symptom before the first attack or between the attacks He had neither nausea nor vomiting, belching of gas nor inability to eat certain foods nor epigastric pain

It seems to me that the evidence is convincing that cholecystitis and cholelithiasis are often latent I mean that the stone cannot be detected or the cholecystitis recognized Here again there is an interesting observation in comparative pathology South American cattle frequently have gall-stones, so frequently, in fact, that the Chinese and Japanese consider this a valuable source for supplying them with material from which they extract dyes for painting chinaware, yet a veterinary surgeon reports that "It is remarkable that of the hundreds of cattle which we have examined daily we have hardly ever met a case of colic among them and very few cases of jaundice" ²⁷ In presumably healthy cattle slaughtered in this country gall-stones are uncommon, roughly speaking, there are fifty pounds of gall-stones exported to the Orient from the slaughter of two million cattle

Now we have no means of knowing just how often young people have slight changes in the gall-bladder wall Many of the finer histological changes cannot be detected at autopsy We do know, however, that the grosser changes and gall-stones are uncommon in the young They occur, but not commonly Kellogg ²⁸ reported a case in a child eleven years old and collected sixty-four from the published reports during the last one hundred years

Gall-stones are made up of cholesterol alone or the combination of cholesterol with calcium salts of bilirubin It is known that bile stasis and infections of low virulence are the chief factors in their production and that, given these conditions, they can be produced experimentally in animals It is recognized in a small percentage of cases that radiate cholesterol stones are found without evidence of infection and that hindrance to the outflow of bile due to adhesions, kinking or congenital peculiarities ²⁹ is the important initial factor in the inspissation of bile and the precipitation of its solids Furthermore, when stones have once formed they soon have the significance

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of an infected foreign body. Infected foreign bodies cause infection to persist. They seem to make it difficult for the bactericidal properties of the cells to kill the microorganisms implanted with them and they furnish an effective means of conveying infection and lodging it elsewhere. In the ducts of glandular tissue their effect in causing blockage and infection is generally recognized and their mechanical presence is a cause of tissue necrosis and perforation. It is very difficult to study the morbid anatomy and symptomatology of cholecystitis without taking into account cholelithiasis. The statement that stone formation is but an incident in the infection of the gall-bladder is misleading. Under the influence of infection they form much more rapidly, I think, than is usually assumed. A recent observation of Cameron³⁰ is interesting. An acutely inflamed, distended, thin-walled gall-bladder was opened, carefully inspected and drained, no stones were found. Eighty-six days after the cholecystostomy the gall-bladder was removed. It was contracted, with thick walls and contained thirty-eight calculi.

There must be a period in the chain of events leading to the formation of calculi when the infection is very slight, periods when a temporary obstruction has passed away and the morbid changes in the wall are disappearing. The question arises in these slight lesions, how are we to determine, which ones will resolve and which ones will go on to stone formation. Are we to remove all gall-bladders in operations in which the laparotomy has been done for pain in the epigastrium and gastric symptoms? Slight thickening of the wall, distention of the gall-bladder, thick and tarry bile and bile with a foul smell, enlarged lymphatic glands near the cystic duct, the alteration in the mucosa known as strawberry gall-bladder, are all given as indications for cholecystectomy. Obviously, in any of these alterations it must be a question of nice judgment to determine when the morbid anatomy is sufficiently advanced to warrant removal.

Several years ago I operated on a middle-aged woman who had had attacks of abdominal pain and gastric symptoms. The pre-operative diagnosis was cholecystitis with cholelithiasis. I found a gall-bladder without demonstrable lesions and removed the appendix only. Eighteen months later she returned with typical biliary colic. The gall-bladder was removed, it contained several stones. I had overlooked, at the first operation, a cholecystitis of sufficient severity to lead to the formation of calculi and pronounced clinical symptoms within eighteen months. On the other hand, I have several times removed the gall-bladder in patients on whom a diagnosis had been made of cholecystitis and who had no stones and slight morbid changes in the gall-bladder wall and who have not been benefited. I recall one who has had more violent pain and more gastric symptoms since the operation than before. The histological examination in this case showed evidence of slight chronic cholecystitis. That the milder degree of cholecystitis, when subjected to operation, will not present a high percentage of cures, was the opinion of W. J. Mayo³¹ ten years ago.

There should be very strong reasons for departing from the sound surgical principle that an organ should not be removed unless there is an obvious lesion. Rules applicable for lesions of the appendix do not hold good for the gall-bladder. The sequence of morbid changes in the gall-bladder is very different from the sequence in the appendix. In the gall-bladder the course is slow, perforation into the free peritoneal cavity is very rare^{32, 33}. The microorganisms are in most instances of low virulence. Gangrene and local necrosis are late, not early lesions.

There is much evidence being accumulated that very slight lesions and attenuated microorganisms are not infrequently found in the gall-bladder wall. None of the clinical tests available enable us to detect these slight lesions. We are told we must rely on the history. The history of biliary colic is characteristic, but I cannot believe that the gastric symptoms alone furnish an equally characteristic picture of cholecystitis³⁴. These symptoms, to some degree, are present in a large percentage of the human race, for example, regurgitation, acid eructation and accumulations of gas are very common in the middle-aged and the inability to eat certain food is almost universal. There is a saying over two thousand years old that "One would laugh at anyone over thirty who would ask counsel of others concerning matters of diet". I have found the same symptoms, on careful inquiry, in patients who had a cholecystectomy and who report themselves well and free from discomfort, they are absent in a considerable group that have well-marked cholecystitis. Gastric symptoms are often found accompanying infections of the gall-bladder, but they are by no means always present, nor are they so characteristic that it is justifiable to remove the gall-bladder without obvious and demonstrable lesions, for these symptoms alone.

Drainage of these mild cases of cholecystitis is notoriously unsatisfactory. If one wishes to convert a slight lesion of the gall-bladder wall with no adhesions into a well-marked lesion with many adhesions, he can not infrequently do so by inserting a drainage tube into the gall-bladder. That these slight lesions set up pancreatitis and hepatitis sufficient to be recognized clinically is questionable. There is nothing to support the contention that lassitude, malaise and biliousness in young people are due to hepatitis and are cured by the removal of the gall-bladder. We have no assurance if we removed all the gall-bladders in all the long-bodied, anæmic young people who complain of pain in the abdomen, capricious appetite and lassitude that in twenty years we will not have an equally large group of patients with cholecystitis and gall-stones in the conspicuously well during adolescence from the same community. The notion that we must excise tissue because bacteria are occasionally found there or because there is evidence that the tissues are destroying bacteria or that the cells are responding to an irritant, does not seem to be justified. I have operated on several old women, one over eighty-five, during the last three years. The lesions in the gall-bladder wall were far advanced. They gave a history of attacks dating back many years. If

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the common duct was not involved they gave no history of years of invalidism. They had led active lives. Three, except during the attacks, were conspicuously well old women.

I am reminded, in reading several of the recent papers, of the surgeon in Mr. Shaw's play, "The Doctor's Dilemma." Mr. Cutler Walpole was rich, able, skillful and confident. He believed ninety-five per cent of the human race had a nuciform sac and that he was the man to remove it.

In Conclusion There have been no reports of serious interference with function or loss of nutrition following the removal of the gall-bladder, although thousands have been removed during the last forty years.

There are occasional reports of damage done to the common duct during simple cholecystectomy, even by operators of large experience.

The removal of a slightly infected gall-bladder or its drainage is accompanied at times by extensive adhesions fixing the pylorus or the duodenum to the under surface of the liver and giving symptoms of interference with the functions of these organs.

The proof that the gall-bladder should be removed for very slight lesions of the wall, accompanied by symptoms of indigestion, seems to me not yet sufficiently established.

It goes beyond demonstrated fact to assume that slight degrees of cholecystitis do not resolve.

The prophylactic removal of a normal gall-bladder does not seem justified.

The proof is not convincing that the majority of infections of the wall of the gall-bladder, sufficient to give symptoms, represent a direct extension to its walls from an inflamed liver through the lymphatics.

That bacteria enter the portal circulation from an obliterated appendix in large enough numbers to produce a hepatitis and cholecystitis recognizable clinically is by no means established.

In the very large percentage of cases of cholecystitis cholelithiasis must be considered as an important factor in determining the initial lodgment, the persistence and the transference of the infection.

Autopsy records and clinical experience furnish abundant evidence of the very slow progression of lesions in the gall-bladder.

The removal of the gall-bladder for gall-stones and well-marked lesions of the gall-bladder wall, uncomplicated by lesions of the common duct, is accompanied by a low mortality and by excellent results.

There is little clinical or autopsy evidence of the association of persistent hepatitis, cirrhosis or pancreatitis when the disease is confined to the gall-bladder wall.

Common duct stones, choledochitis and cholangitis are late lesions and have a high mortality, and patients should come to operation before these lesions develop.

WALTON MARTIN

TABLE I

Mortality Statistics in 229 Cases of Cholecystectomy In 229 Cases There Were 4 Deaths, or 1.7 Per Cent

- 1 Died of pulmonary embolus ten days after operation
 - 2 Died twenty-six days after operation Diagnosis at autopsy Cholecystectomy with abscess in gall-bladder bed and abdominal wound Cerebral hemorrhage Infected infarct of left lung Bronchopneumonia Arteriosclerosis Chronic nephritis
 - 3 Worn out, dehydrated woman Temperature rose rapidly after operation Died on third day Temperature 107
 - 4 Old woman with chronic nephritis and endocarditis Died forty-eight hours after operation Probable cause of death sepsis
- In 38 cases with stones in the common duct there were 9 deaths, a mortality of 23 per cent

TABLE II

Follow-up Report on 321 Cases of Infection of the Biliary Tract Treated by Cholecystectomy

- 84 per cent report themselves as free from all symptoms
 Of the remaining 16 per cent
- 34 per cent have had pain but have gained weight
 - 16 per cent have had pain and lost weight
 - 16 per cent have had pain, vomiting* and have gained weight
 - 7 per cent have had pain, vomiting* and have lost weight
 - 13 per cent have had pain, vomiting* and jaundice (Of these, three returned to the hospital and had stones removed from the common duct)
 - 14 per cent have had complications (That is, some other illness making it difficult to classify the results)

* Vomiting coming on in attacks and often very severe is not uncommon For twenty-four hours almost everything is vomited Strangely enough some of these patients have shown a marked gain in weight

There were six hernias, or 1.8 per cent

TABLE III

Weight Record in 128 Gall-bladder Cases Patients Listed as Free from Symptoms

The weight record of a group of cases following cholecystectomy has been given to show the excellent nutrition maintained after the gall-bladder was removed, a condition which is not compatible with any serious disturbance of function, or persistent lesions in pancreas or liver Ninety per cent gained weight, 10 per cent lost weight

The actual weight in 102 cases in the months observed are as follows

Amount of weight gained	Months observed
lbs	
5	48
20	12
15	15
17	30

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Amount of weight gained lbs	Months observed
12	30
4	28
11	18
7	36
15	38
17	48
20	16
50	60
35	24
6	42
20	42
25	34
45	50
4	36
14	24
8	30
49	27
15	24
20	30
21	48
15	60
22	32
60	36
15	20
14	2
5	21
10	24
52	15
20	28
20	21
20	29
5	24
10	14
4	14
20	8
42	42
45	18
13	8
13	12
10	20
3	24
9	12
20	18
25	15
8 $\frac{3}{4}$	17
4	8
8	15
20	26
10	2
30	30

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Amount of weight gained lbs		Months observed
10		2
50		12
20		24
20		15
30		12
10		2
10		15
7½		36
15		21
15		60
8		30
3		34
26		12
3		10
11		60
10		30
15		20
25		36
14		44
29		40
19		54
15		32
10		31
44		36
60		60
15		24
10		18
12		24
15		39
25		60
21		18
3		48
24		60
6		12
Amount of weight lost lbs		Months observed
10		7
4		17
13	(Intentional)	2
22		24
9		12
7		20
20		48
8		48
4		36
5		40
10	(Intentional)	24
36	(Due to other illness)	40
5		20
2		54

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TABLE IV

In a series of 174 cases in which the gall-bladder and appendix were removed, the lesions were reported as follows

Acute Cholecystitis	{	Acute cholecystitis	}	5
		Normal appendix		
	{	Acute cholecystitis	}	5
		Chronic appendicitis		
Subacute Cholecystitis	{	Subacute cholecystitis	}	9
		Normal appendix		
	{	Subacute cholecystitis	}	2
		Subacute appendicitis		
{	Subacute cholecystitis	}	11	
	Chronic appendicitis			
Chronic Cholecystitis	{	Chronic cholecystitis	}	53
		Normal appendix		
	{	Chronic cholecystitis	}	3
		Acute appendicitis		
	{	Chronic cholecystitis	}	4
		Subacute appendicitis		
{	Chronic cholecystitis	}	82	
{	Chronic appendicitis	}		

In 38 per cent the appendix was normal

In 62 per cent there was a lesion of the appendix

The reports by the pathologist taken from the microscopical findings have not in many instances agreed with the lesions as described by the surgeon at the time of the removal of the tissue, for example, the pathologist reports subacute cholecystitis and subacute appendicitis whereas the surgeon describes the same lesion from macroscopic examination as acute cholecystitis and chronic appendicitis

For comparison, in a series of 115 cases in which both tubes and appendix were removed, the lesions were reported as follows

Acute Salpingitis	{	Acute salpingitis	}	1
		Normal appendix		
	{	Acute salpingitis	}	2
		Acute appendicitis		
	{	Acute salpingitis	}	1
		Chronic appendicitis		

Subacute Salpingitis	Subacute salpingitis Normal appendix	8
	Subacute salpingitis Acute appendicitis	2
	Subacute salpingitis Subacute appendicitis	7
	Subacute salpingitis Chronic appendicitis	17
Chronic Salpingitis	Chronic salpingitis Normal appendix	39
	Chronic salpingitis Acute appendicitis	2
	Chronic salpingitis Subacute appendicitis	3
	Chronic salpingitis Chronic appendicitis	33

In 42 per cent there was a normal appendix

In 58 per cent there was a lesion of the appendix

BIBLIOGRAPHY

- ¹ Langenbuch, C Ein Fall von Extirpation der Gallenblase wegen chronischen Cholelithiasis Heilung Berlin klin Wochenschr, 1882, vol xix, p 725
- ² Luciani Fisiologia Dell'Uoma, 1910, vol 11, p 237
- ³ Mann, E C The Function of the Gall-bladder, an Experimental Study Coll Papers, Mayo Clinic, 1918, vol x, p 94
- ⁴ Owen, Richard The Anatomy of Vertebrates, 1866, vol 11
- ⁵ Knox, Leila C Congenital Absence of Gall-bladder Proc N Y Path Socy, 1922, vol xxii No 6, p 8
- ⁶ Dangschat, E Der einfluss der Cholelithiasis und Cholecystectomy auf der sek Funk des magens und duodenums Beitr z Klin Chir, 1923, vol xxxviii, p 605
- ⁷ Flint, E R Abnormalities of the Right Hepatic, Cystic and Gastro-duodenal Arteries and of the Bile Ducts Brit Jour Surg, 1923, vol x, p 509
- ⁸ Coventry, W A Cholecystectomy without Drainage Surg, Gyn and Obs, 1923, vol xxxvii, p 212
- ⁹ Kehr M Ueber einige zurzeit besonders "aktuelle" Streitfragen aus dem Gebiete der Cholelithiasis Ergbn d inn Med u Kinderheilk, 1914, vol xiii, p 198
- ¹⁰ Moynihan Gall-stones and their Surgical Treatment, 1905, p 190
- ¹¹ The Veterinary Journal Gall-stones in a Horse, 1913, vol xx, p 31
- ¹² Quinke und Hoppe-Seyler (Nothnagel Series) Die Krankheiten der Leber, p 197
- ¹³ Mayo, C H Cholecystectomy versus Cholecystostomy Coll Papers, Mayo, Clinic, 1915, vol vii, p 256
- ¹⁴ Cullen-Darner The End Results in Nearly Three Hundred Cases in Which the Gall-bladder Was Drained—not Removed Surg, Gyn and Obs, 1923, xxxvii, p 579
- ¹⁵ Graham, Evarts A Newer Conceptions of Pathogenesis of Infections of Biliary Tract Archiv Surg, 1922, vol iv, p 23

QUESTIONS IN GALL-BLADDER SURGERY

- ¹⁶ Wharton, H R A Case of Acute Cholecystitis Following Acute Appendicitis Trans Am Surg Assoc, 1909, vol xxvii, p 540
- ¹⁷ MacCarty, Wm C Classification of Appendicitis Coll Papers, Mayo Clinic, 1910, p 235
- ¹⁸ Rosenow, E C The Etiology of Cholecystitis and Gall-stones and their Production by Intravenous Injection of Bacteria Jour Inf Diseases, 1916, vol xiv, p 527
- ¹⁹ Zinsser, Hans Text-book of Bacteriology, 1922, p 424
- ²⁰ Adams Principles of Pathology, 1908, vol 1, p 424
- ²¹ Huxley Lessons in Elementary Physiology, 1885, p 11
- ²² Judd and Herbst Surgery of Acute Conditions of the Gall-bladder Coll Papers, Mayo Clinic, 1922, vol xiv, p 171
- ²³ Whipple, A O Pancreatic Asthenia ANNALS OF SURGERY, 1923, vol lxxviii, p 177
- ²⁴ Judd and Lyons The Mortality Following Operations on the Liver, Pancreas and Biliary Passages ANNALS OF SURGERY, 1923, vol lxxviii, p 194
- ²⁵ Sistrunk, W E The Surgical Removal of Pancreatic Stones, A Report of Cases Trans Am Surg Assoc, 1921, vol xxxix, p 107
- ²⁶ Mayo, W J "Innocent" Gall-stones a Myth Coll Papers, Mayo Clinic, 1911, p 136
- ²⁷ Morgan, E Veterinary Journal London, 1920, vol lxxvi, pp 63-66
- ²⁸ Kellogg, E L Gall-bladder Diseases of Childhood ANNALS OF SURGERY, 1923, vol lxxvii, p 587
- ²⁹ Seelig, M G Bile Duct Anomaly as a Factor in the Pathogenesis of Cholecystitis Surg, Gyn and Obs, 1923, vol xxxvi, p 331
- ³⁰ Cameron, A L The Time Element in Gall-stone Formation Jour A M A, 1923, vol lxxx1, p 1671
- ³¹ Mayo, W J Cholecystitis without Stones or Jaundice in Its Relation to Chronic Pancreatitis Coll Papers, Mayo Clinic, 1913, p 246
- ³² Cotte and Arnaud Traitement des Perforations Biliaires en Plein Peritone Revue de Chir, 1911, vol xliii, p 339
- ³³ McCreery Acute Perforation of the Free Peritoneal Cavity without Cholecystitis Trans N Y Surg Socy, Nov 14, 1923
- ³⁴ Hartman, H R Diseases of the Biliary System Coll Papers, Mayo Clinic, 1922, vol xiv, p 148

ANÆSTHESIA OF THE SPLANCHNIC NERVE IN ABDOMINAL OPERATIONS

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IN the year 1892, Schleich published a method of local anæsthesia invented by him, and in 1894, he reported twenty-eight laparotomies which he had performed entirely under local anæsthesia. Among these cases there were three gastrostomies and two cholecystostomies. Friedlander reported in 1900, sixty-eight cases in which he had used local anæsthesia, among them were five gastrostomies, two colostomies, two ovariectomies.

In 1904, Baker reports that in his clinic, abdominal operations were done entirely under Schleich's local anæsthesia or in combination with general narcosis. In Mikulicz's clinic, as reported by Gottstein, in 1896-98, twenty-two operations upon the stomach were performed under local anæsthesia alone.

Since the appearance of these publications, local anæsthesia has gained more and more in favor among surgeons, so that now in all surgical clinics a great proportion of operations are carried out under some form of local anæsthesia. A great impetus was given to this method by the substitution for cocaine of drugs which were less poisonous and equally effective and which therefore could be used in larger quantities. The standard drug at present for local anæsthesia is a one-half per cent and a one per cent solution of novocain in combination with or without suprarenin.

In this paper I shall not go into elaborate discussion of local anæsthesia in general, but shall confine myself to the method of anæsthesia of the splanchnic nerves in operations upon intra-abdominal organs, especially in operations upon the stomach and the biliary system.

The application of local anæsthesia on the extremities and the surface of the body was comparatively simple. The innervations of these regions were known and they were easily accessible. The moment, however, we tried to attack the intra-abdominal organs under local anæsthesia, the problem became more difficult and complicated.

The first to investigate the intricate sensory nerve apparatus of the abdominal organs was Lennander. From his investigations, he drew the conclusion that the sympathetic nervous system did not convey any sensory impulses and that all organs which were innervated by the vagus, below the origin of the recurrent nerve, or by the sympathetic, were not sensitive to pain, pressure, cold or heat. Omentum and mesentery he also proclaimed to be insensitive to pain. According to him the parietal peritoneum is very sensitive. The pains elicited by stretching and pulling on the mesentery are caused by the irritation of the intercostal nerves of the cerebrospinal system which innervate the parietal peritoneum of the posterior abdominal wall.

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The results of Lennander's investigations, however, do not tally with later experimental and clinical experiences. Kast and Meltzer found that the normal intra-abdominal organs were sensitive to pain and that this sensitiveness was very much augmented if the parts were inflamed. Wilms concluded that the whole intestinal tract, as such, had no pain sensation, but that sensory impulses were conveyed to it by the fine nerve-filaments running in the mesentery along with the mesentery vessels.

Ritter believes that all abdominal organs are sensitive to pain and that the anæsthesia is not produced by the injected drug but by the action of the air upon the fine nerve filaments. Propping lays stress upon the painful sensations patients complain of when the mesenteric vessels are tied and Finsterer points out that the patients do not experience any pain when all pulling and stretching of the mesentery is avoided. A. W. Meyer states that the stomach and intestines, including their serous coats, are not sensitive to pain, that the mesentery, however, is very much so.

Mueller (1912), in his histological studies, states that according to the opinion of the authors the splanchnic nerve carries fibres of sensation. The pain which accompanies tabetic crises is another proof that there exist sensory fibres in this nerve which enter the posterior spinal roots by way of the spinal ganglia.

By the investigations of Burger and Churchmann (1915) the fact was established that irritation of the abdominal ganglia and of the splanchnic nerve are followed by severe pain-sensations.

Mueller calls attention to the fact that the character of abdominal pain during gall-stone-colic and renal-colic is entirely different from the pain which is caused by irritation of spinal nerves. Whereas the latter pain is strictly localized, the pain caused by irritation of the visceral nerves radiates through the whole vegetative system and can be associated by vasomotor disturbances, pallor of the face, flow of saliva and perspiration and elevation of blood-pressure. If these visceral pains are excessive they can become unbearable and cause the feeling of impending death as in angina pectoris.

Kappis and Naumann after experiments on dogs come to the following conclusions:

Abdominal organs have practically no sensation, for the reason that either the nerve fibres disappear before reaching the organ, or the fibres which reach the organs are too fine and too few in number. However, those regions to which the nerve fibres penetrate in sufficient number and calibre are strongly sensitive. These regions are the mesentery, the lesser omentum, the attachment of the large omentum to the stomach, the region of the common bile duct, cystic duct, hepatic duct, and hilus of the liver, the hilus of the kidney and the neighborhood of the large vessels. The irritation travels by way of the abdominal ganglia through the splanchnic nerves, the rami communicantes of the lumbar nerves, and through all branches of the sympathetic.

The view of Laiguel-Levastine that the vagus was the carrier of abdominal

impulses, was challenged by the observations of Th Kocher and has been definitely abandoned. The clinical and experimental experiences have confirmed Kocher's observation and to-day it is considered certain that the sympathetic alone carries sensory impulses from the abdominal organs to the cerebrospinal system.

In 1911, Kappis and Finsterer tried to achieve an anæsthesia of the abdominal cavity by blocking the communicating branches of the sympathetic by their method of paravertebral anæsthesia.

Laewen tried to popularize this method, but it never gained much favor on account of its complicated technic.

Wendling published a method of blocking the splanchnic nerve by injection from the anterior abdominal wall. He inserted the needle 1 cm below the xyphoid process and one-half cm to the left of the median line without taking in consideration the underlying organs, liver, stomach, pancreas, colon. Wendling had good results and reported thirty-six cases with only one failure. This method has not been followed by anybody else as the danger from injuring hollow organs with ensuing complications is too obvious.

Anatomy of sympathetic nerve. The sympathetic, vegetative, visceral or autonomous nervous system (Langley), which supplies the involuntarily active organs, can be divided anatomically as well as physiologically and pharmacologically into two large groups.

(1) The cranio-bulbar and sacro-autonomous system (by Langley called parasympathetic system).

Its fibres originate in the midbrain, in the bulb and the sacral part of the spinal column. From the midbrain the parasympathetic nerve fibres pass through the nervus oculomotorius to their end organs: musculus sphinctor pupillæ and musculus ciliaris. From the medulla oblongata or the bulb they pass through the facial nerve, the intermediate, the glossopharyngeal and the vagus to the lacrimal, salivary and the buccal glands of the naso-pharynx, to the trachea, lungs, heart, liver, pancreas, kidneys, stomach, ileum and proximal colon, from the upper sacral part through the pelvic nerve to the distal colon, rectum, bladder and genitals.

(2) The sympathetic system proper or thoraco-lumbar autonomous system, derives its fibres from the thoracic and lumbar part of the spinal cord.

The characteristic feature of the entire vegetative nervous system is its common pharmacological reaction towards nicotine. Another characteristic is that the vegetative nerve fibres, in contradistinction to the animal nervous system, never travels directly to its endorgan, but passes into a ganglion where it is split up. From here it goes forth as a new neuron to reach its peripheral organ. This transformation takes place either in the sympathetic trunk or in the vertebral or in the prevertebral ganglia (for instance, cæliac ganglia and mesenteric ganglia). Upon these ganglia nicotine has the effect of complete paralysis after a short period of stimulation.

ANÆSTHESIA OF THE SPLANCHNIC NERVE

The sympathetic and parasympathetic nervous systems are so to speak, pharmacological antagonists

The sympathetic system is stimulated by adrenalin, *i.e.* adrenalin augments the action of the sympathetic fibres, irrespective of whether they are normally augmentor or depressor fibres

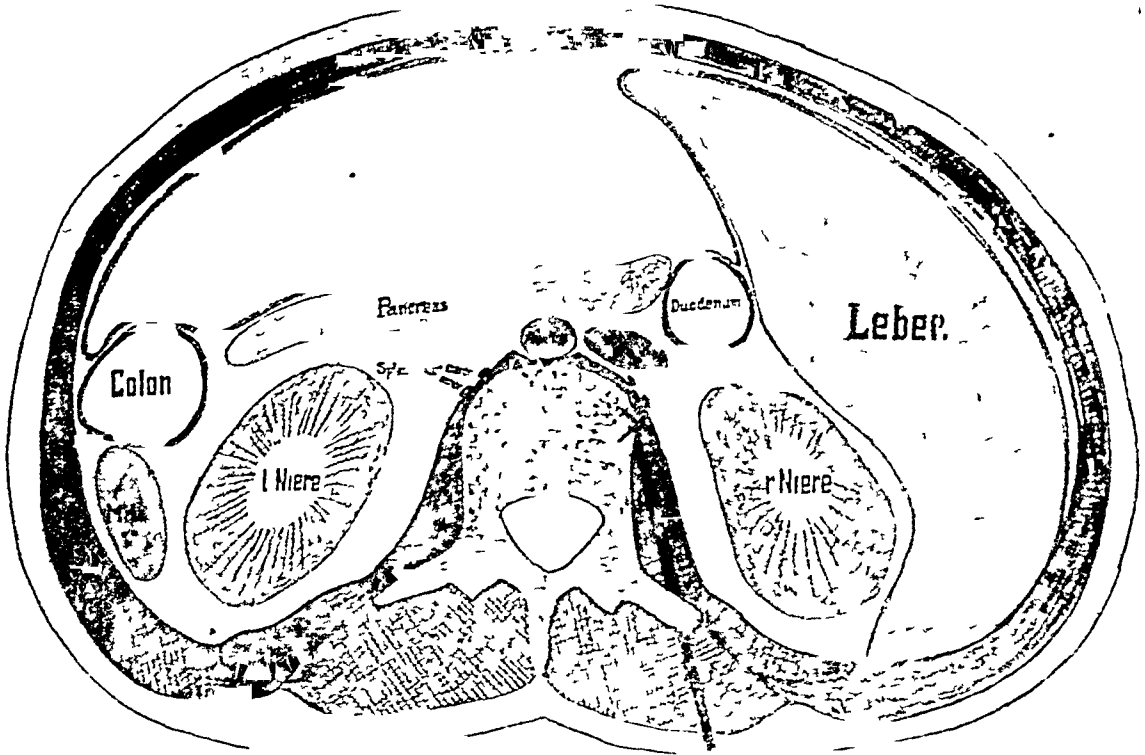


FIG 1 —Cross section of body at the level of the first and second lumbar vertebrae to show situation of injection needle (After Kappis)

The parasympathetic system is depressed by atropin and stimulated by muskarine, pilocarpine, physostigmine and cholin

Nicotine attacks the ganglia

Atropin, adrenalin, muskarine, etc., attack the peripheral nerve endings

Besides these two vegetative nerve systems there is in existence a third one which is autonomous. Langley calls it "enteric system" (Auerbach and Meissner's plexus for stomach and intestine). This system is imbedded in its endorgan.

The sympathetic nervous system is situated on either side of the vertebral column. It consists of the trunks of the sympathetic nerve, formed by a large number of ganglia which are connected with each other by the so-called interganglionic branches. In the thoracic and lumbar portion they are strictly arranged according to segment: one ganglion corresponds to each intercostal nerve. This segmental arrangement, however, does not obtain in the cervical and lumbar regions.

In the region of the neck there are only three, or even only two, ganglia, ganglion cervicale superius, medium and inferius.

The sympathetic trunks in the cervical and thoracic region run down on either side of the vertebral column, converging somewhat in the lower thoracic region where they run more mesially, in the lumbar region they keep to the midline in front of the vertebræ, diverge again in the sacral region. Just above the coccyx they unite, forming the ganglion impar. The sympathetic trunks communicate by the rami communicantes with the central nervous system.

The nervus splanchnicus major arises with four or five roots from the 6th, 7th, 8th, and 9th thoracic ganglia of the sympathetic trunk sometimes getting fibres from the 5th, and sometimes from the 10th. These four roots, after uniting, form the splanchnic nerve, which has the thickness of a match. It travels downward immediately on the vertebræ, covered by the pleura. It pierces the diaphragm between its crura. It is accompanied on the right by the vena azygos, on the left by the vena hemiazygos and going over to the midline terminates in the semilunar ganglia.

The splanchnicus minor arises with two or three roots from the 10th, 11th, and 12th thoracic portion of the sympathetic trunk. It pierces the diaphragm, lying laterally to the splanchnicus major, between it and the sympathetic trunk. It ends with a smaller part of its fibres in the semilunar ganglia and with a larger part in the renal and suprarenal plexus. (Fig 3.)

The two semilunar ganglia from the solar plexus and its secondary plexus (phrenic plexus, suprarenal plexus, renal plexus, spermatic plexus, superior gastric plexus) are supplied by (1) The two splanchnic nerves (2) The abdominal branches of both vagi (3) Several direct branches of the lumbar sympathetic trunks.

The vagi have nothing to do with the sensibility of the abdominal organs as we know to-day. The anæsthetization of the abdominal organs can therefore only be accomplished by blocking of the splanchnics and the lumbar sympathetic trunk.

The technic of anæsthesia of the splanchnic nerve as worked out by Kappis is as follows:

The patient lies on his side with his back bent as much as possible. After disinfection of the skin a small wheal is made 7 cm. laterally from the midline just below the lower border of the 12th rib. At this place a long needle is pushed in at an angle of 30 degrees to the sagittal plane of the body. After penetrating to the depth of 6 to 8 cm. the needle strikes the lateral surface of the vertebræ. Along the lateral surface the needle is pushed forward until its point is free, it now lies at the junction of lateral and anterior surface of the vertebræ, where the splanchnic nerves and the sympathetic ganglia are situated. Twenty to forty c.c. of a 1 per cent solution of novocain-adrenalin are slowly injected. The same procedure is repeated upon the other side. In this way the splanchnic nerves are blocked on both sides. To block also the lumbar region, Kappis has recommended to inject 10 to 20 c.c. at the level of the transverse process of the first lumbar vertebra.

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Lately he has changed his technic a little in such a way that he directs his needle from the point of insertion a trifle towards the head, in order to be able to reach the trunks of the splanchnics before they pierce the diaphragm (Fig 1)

The frequent aspiration of blood is mostly caused by injuring the intercostal vessels. To avoid this injury, Preiss recommends pushing in the needle on either side through the intervertebral cartilage. However, one has to be a little careful not to break the needle.

The needle should be at least 12 cm long, of 0.75 mm calibre. Kappis also recommends, in order to reach the lumbar portion of the sympathetic trunk, the injection of 10 to 20 cc at the level of the transverse process of the first lumbar vertebra, this point is about 3 cm below the first point of insertion.

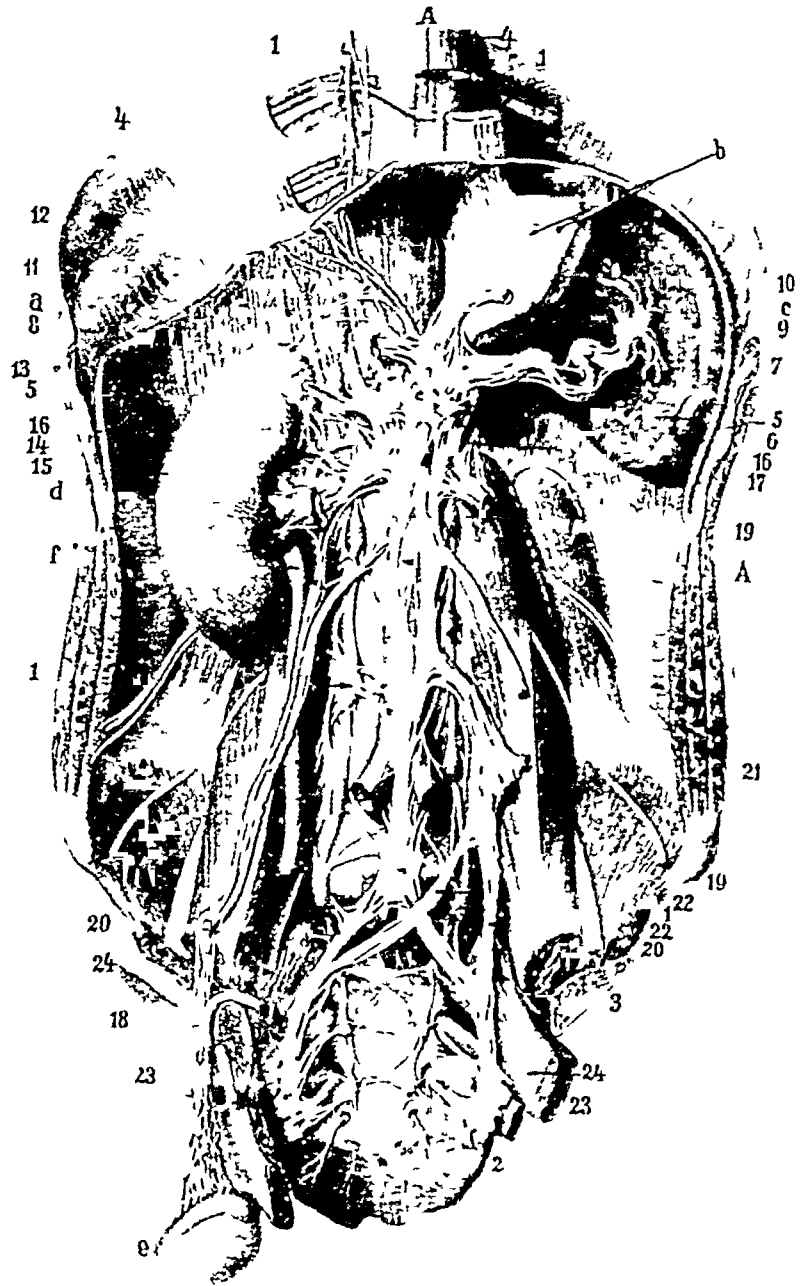


FIG 2—The abdominal sympathetic plexus (From Hirschfeld and Leveillé) A Aorta a Diaphragm b Stomach c Spleen d Kidney and adrenal e Testis f Ureter 1 Sympathetic trunk 2 Ganglion impar 3 Anastomosis of the two sympathetic trunks 4 Splanchnicus major 5 Semilunar ganglia 6 Solar plexus 7 Splenic plexus 8 Hepatic plexus 9 Coronary plexus of stomach 10 Vagus 11 Diaphragmatic plexus 12 Branches of the phrenic nerve 13 Plexus suprarenalis 14 Plexus capsularis inf 15 Plexus renalis 16 Splanchnicus minor 17 Pl mesent sup 18 Pl spermat 19 Pl lumbo aorticus 20 Division of some 21 Plex mesent inf 22 Anastomosis with pl hypogastric 24 Plex sacralis

Preiss has found in his anatomical studies that the best way to reach the lumbar ganglia of the sympathetic trunk is to insert the needle at the level of the third lumbar vertebra. From this point a good diffusion of the anæ-

thetic can be accomplished which reaches from the second lumbar vertebra down to the promontory

He has tried this method so far on three patients with one failure (1 appendicitis, 1 ileus, 1 carcinoma of the pylorus with resection) He injected 20 c c of 2 per cent novocain, on either side, in two cases, in the last case 25 c c of a 1 per cent solution

Although in a large majority of cases the injection from a point immediately below the lower border of the 12th rib is sufficient, in some operations on kidneys, spleen and colon the addition of the lower injection is advisable Amount of fluid to be injected varies with different operators Kappis originally used 120 c c of 1 per cent novocain adrenalin solution Lately he uses 100 0 of $\frac{1}{2}$ per cent solution Wendling, 80 c c of 1 per cent solution Buhre, 100 c c of 1 per cent solution Naegele, 70 0 of 1 per cent solution Drimer, only $\frac{1}{4}$ per cent solution in very small quantity, not using more than 0 5 novocain in substance pro patient Hoffmann uses novocain 0 5 of 2 per cent solution, potassium sulphate 20 0 solution, sodium chloride (0 9 per cent) ad 100 0, solution adrenalin hydrochloride (1°/00) gtts xii Preiss uses the following novocain 2 0, aqua destillata 100 0, suprarenin 0 002, sodium chloride 0 7, potassium sulfate 0 4 and injects 80 c c He uses 2 0 to 2 35 of novocain in substance as maximum In spite of these large doses (0 5 maximum dose after Hoechst) he met with no signs of intoxication or collapse No kidney irritation Sometimes slight pallor and off and on vomiting Blood-pressure not abnormally high or low Preiss does not prepare the patient with other narcotics before operation, except 0 01 morphine or 0 02 pantopon

Braun and Buhre recommend to block the splanchnic nerves from in front after opening of the abdominal cavity, in the following way Infiltration anæsthesia of abdominal incision down to parietal peritoneum After opening of the abdominal cavity the liver is lifted up, the stomach, if necessary, is pushed over to the left side By palpating with the index finger the anterior surface of the lumbar vertebræ is sought for The aorta is pushed towards the left side and the needle pushed down to the anterior surface of the vertebræ, here 100 c c of $\frac{1}{2}$ per cent of novocain adrenalin is deposited Anæsthesia follows almost immediately after injection Drimer recommends to inject above the small and large curvature of the stomach, in the region of the cæliac axis, in the region of the duodenum and the pedicle of the liver, and in the region of the superior and inferior mesenteric vessels

Preiss has used the method in 192 operations, with additional narcosis in 23 In 64 cases morphine was given before operation (Aether-Rausch) The anæsthesia lasted from two and one-half to several hours

I have made use of this anæsthesia in five cases of operations upon the stomach, in one case of carcinoma of the pancreas and three gall-bladder cases My personal impressions in these few cases have been very favorable I had one complete failure and one partial failure, in a case of resection of the

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stomach, in which the anæsthesia did not last long enough and in which ether had to be administered for completion of the anastomosis and the abdominal sutures

It is undoubtedly a very satisfactory method of anæsthesia in severe surgical conditions of the upper abdomen where we feel that a general anæsthesia would be better avoided. Personally I have not observed any ill effects from this mode of local anæsthesia and do not hesitate to recommend it in suitable cases. The technic is not any more difficult than that of a spinal anæsthesia.

CASE REPORTS, SPLANCHNIC ANÆSTHESIA

CASE I—E. Sch., age sixty-four. *Inoperable carcinoma of the stomach*. Splanchnic anæsthesia with 80 cc of 1 per cent novocain adrenalin solution and 50 cc of $\frac{1}{2}$ per cent novocain adrenalin solution for infiltration of midline abdominal incision from ensiform cartilage to umbilicus.

Anæsthesia complete. No pain upon spreading apart of wound with large retractors. Stomach and neighboring organs can be handled freely without any pain sensation. Stomach can be pulled out of wound without pain. Large carcinomatous mass involving larger part of stomach along greater curvature with metastasis in omentum. Tumor considered inoperable. Closure of wound.

CASE II—H. H., age sixty-five. *Carcinoma of stomach*. Splanchnic anæsthesia. Sixty cc of novocain adrenalin solution, 1 per cent, and 25 cc of novocain adrenalin solution, $\frac{1}{2}$ per cent, for anæsthesia of abdominal wall. On first insertion of needle into back some blood appeared, therefore withdrawal of needle. Another attempt succeeded without causing hemorrhage, but one has the sensation as though needle does not reach desired depth on account of its being too short ($3\frac{1}{2}$ inches, 9 cm.).

On opening abdominal cavity and exploring stomach very violent pain. parietal peritoneum very sensitive, no possibility of exploring of stomach as patient cries out with pain. Complete failure, probably on account of shortness of needle.

Therefore general ether anæsthesia was given. While he was being anesthetized he suddenly went into collapse, withdrawal of ether and hasty closure of abdominal wound. Hasty exploration had demonstrated a large carcinomatous tumor at the pylorus, of the size of a large man's fist, which, however, was freely movable and probably could be removed.

Therefore one week later, another attempt at radical operation was made.

Splanchnic anæsthesia as before but with a needle 12 cm long. Same amount of anæsthesia was used. Anæsthesia very good. Exploration of upper abdomen perfectly



FIG. 3.—Sympathetic nerve and nervus splanchnicus major and minor of left side. 1 Sympathetic nerve (main trunk) 2 Sympathetic ganglion 3 Communicating branch 4 Splanchnic major 5 Splanchnic minor 6 Injection needle

painless Stomach can easily be pulled out through wound and with it the colon transversum The tumor involving the stomach had also grown by extension into the mesocolon and into the wall of the colon transversum A resection of the stomach, together with a large part of the colon transversum, was done The operation was difficult and tedious The patient gave the first signs of distress after the tumor had been removed (operation had then lasted one and one-half hours) when an attempt was made to pull the stump of the stomach forward to make the anastomosis with the jejunum This pain, however, lasted only for the short time it was needed to place an addition-clamp The anastomosis (Balfour-Polya) could be finished painlessly the anæsthesia of the abdominal incision, however, had passed off (after two hours) so suture of the abdominal wall was painful The patient had stood the extensive operation very well, had no signs of collapse, his pulse being about 90-100 during the whole operation This was certainly a great success when one considers that at the previous attempt the patient promptly collapsed after the administration of a few cc of ether

Although the patient had stood the operation itself very well, he began to show signs of exhaustion on the second day after operation and died the same night with signs of heart failure

CASE III.—S J, age forty-five *Large penetrating ulcer of the posterior wall of the stomach near the lesser curvature, floor of ulcer adherent to pancreas Balfour-Polya resection of stomach Splanchnic anæsthesia* Eighty cc of 1 per cent novocain adrenalin solution Thirty cc for abdominal incision Anæsthesia perfect for one and one-half hours, after this time it gradually wore off and patient had much pain and discomfort while placing clamps for gastrojejunal anastomosis

It became necessary to give a few cc (140 cc) of ether to do anastomosis and to close the abdomen

CASE IV.—S H *Cholecystitis, pericholecystic abscess, sepsis Death on table* Patient in very poor condition Was almost moribund when put on table Splanchnic anæsthesia Eighty cc of $\frac{1}{2}$ per cent novocain adrenalin solution, 140 cc of novocain adrenalin solution for incision of abdominal wall

Gall-bladder, stomach, duodenum, omentum and colon tightly adherent to one another, opening of large peri-cholecystic abscess No evidence of pain during operation

Sudden collapse on table and death This death cannot be attributed to the method of anæsthesia, patient's condition was almost hopeless before she came to operation

CASE V.—M R. *Exploratory laparotomy for a probable ulcer of the stomach Splanchnic anæsthesia* Seventy cc of $\frac{1}{2}$ per cent novocain adrenalin solution, 30 cc of $\frac{1}{2}$ per cent novocain adrenalin solution for abdominal anæsthesia Complete failure Thorough exploration of stomach cannot be done on account of severe pain and pressing of patient and the administration of a general anæsthesia became necessary

CASE VI.—R F *Cholelithiasis Extirpation of gall-bladder Cure Splanchnic anæsthesia* Thirty-five cc into area of twelfth dorsal vertebra, 15 cc into area of first lumbar dorsal vertebra, 60 cc for abdominal wall of 1 per cent solution

Anæsthesia was successful, although patient here and there showed evidence of a little pain Patient was a little nervous and probably more frightened than anything else Operation could be completed without general anæsthesia

CASE VII.—A *Chronic jaundice Carcinoma of pancreas*

CASE VIII.—H P *Resection of stomach Balfour-Polya Death from broncho-pneumonia*

CASE IX.—C K *Cholecystectomy, for persistent biliary fistula* Operation very difficult on account of previous cholecystotomy Many very extensive adhesions between gall-bladder, stomach, duodenum, colon transversum had to be severed Anæsthesia was perfect Skin suture was a little painful

ANÆSTHESIA OF THE SPLANCHNIC NERVE

REFERENCES

- Kappis Bruns Beitr, Bd 115, Centrbl f Chir, 1929, No 5
Naegeli Centrbl f Chir, 1919, No 52
Preiss and Ritter Centrbl f Chir, 1919, No 52
Graf Centrbl f Chir, 1921, No 9
Preiss Deutsche Wehnschr f Chn, vol cliv

AN IMPROVED ABDOMINAL RETRACTOR

BY JOSEPH L. DECOURCY, M.D.

OF CINCINNATI, OHIO

THE abdominal retractor herewith pictured has been used by members of the DeCourcy Clinic, for the past five years, and was not published before

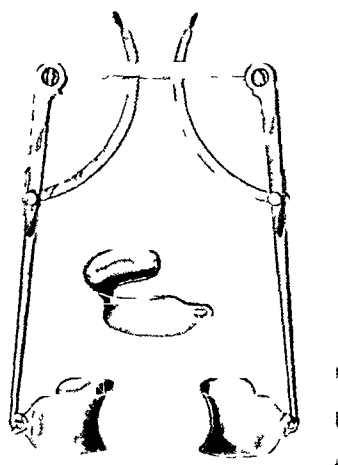


FIG 1 —Abdominal retractor showing side view of blade

it had proven itself satisfactory in every way. The special features which it typifies are as follows:

1 Because of its square base, it remains stationary upon the abdominal wall and does not move from side to side, as was our experience previously, with other retractors.

2 The blades adopt themselves to fat and thin abdominal walls, thereby preventing the necessity of changing blades.

3 The exposure obtained is at once adequate and uniform for all work upon the lower abdomen and pelvis.

4 After using on several cases the handling becomes mechanical and is done subconsciously.

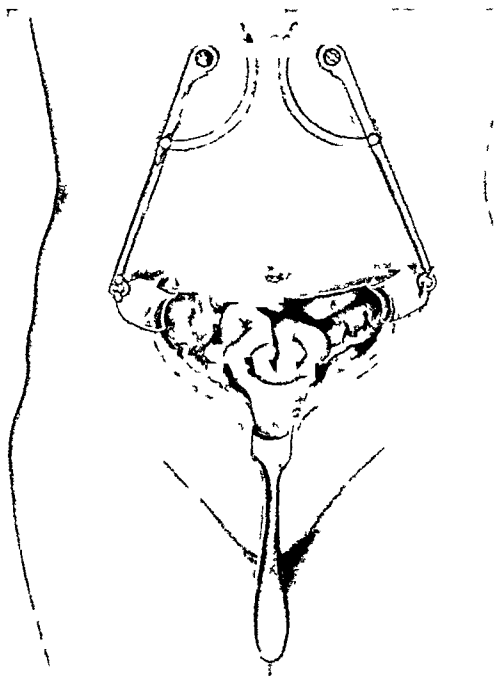


FIG 2 —The retractor in position

TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

Stated Meeting Held November 28, 1923

The President, DR EUGENE H POOL, in the Chair

PANCREATIC CYST

DR HERMANN FISCHER presented a man, age forty-eight years who was admitted to hospital August 30, 1923, suffering from pain and discomfort in upper abdomen. In July, 1923, he had first noticed a severe burning pain in the pit of the stomach, for which he was treated medically with some relief. He drank heavily at that time and very soon the pain returned with the same severity. It was now not confined to the epigastrium alone, but radiated into the left side to the back and towards the left shoulder. In the latter part of August he was taken with attacks of vomiting at short intervals. This attack lasted about thirty hours, during this period he was also troubled with violent hiccoughing. He was a man of very powerful physique who did not look very ill. Loss of weight insignificant. The abdomen was soft, without rigidity. Below the left costal arch, in the region of the left rectus muscle, there could be seen and felt a tumor of the size of a grapefruit. It is round and has a semi-fluctuating elastic feeling. It is not very painful and does not move on respiration. It seems to be situated below and somewhat in front of the stomach and above the transverse colon. It is not in connection with the spleen, which is not palpable and which percusses normally. Liver can be felt slightly below costal margin and is smooth and not sensitive. Kidneys are not palpable. No other masses can be felt in abdomen.

Fluoroscopic with roentgenographic examination, reveals a marked defect involving the major part of the greater curvature of the stomach. This defect is not constant in the different positions. At the six-hour period the stomach is empty.

Stereoscopic roentgenograms after barium enema reveal a distinct pressure defect involving the distal transverse colon and the splenic flexure. The film taken after defecation shows good colonic function with considerable stasis in cæcum and ascending colon. The above findings indicate a tumor mass causing pressure defect on the greater curvature of the stomach.

The diagnosis was Large pancreatic cyst which has grown forward between the large curvature of the stomach and the transverse colon, behind the gastro-colic ligament.

Operation September 6, 1923. On opening the peritoneum a large cystic tumor of bluish color was found lying between the great curvature of the stomach and the transverse colon, covered by the gastro-colic ligament. The tumor seems to fill the whole bursa omentalis reached toward the right as far as the hepatic-duodenal ligament, the foramen of Winslow was closed by the mass which also extended towards the left to the hilus of the spleen. It was so intimately adherent to the surrounding structures that extirpation was not considered practicable.

The gastro-colic ligament was divided between ligatures and the anterior surface of the cyst is exposed, the edges of the gastro-colic ligament were sewn the parietal peritoneum thereby closing off the general cavity before the

cyst was opened. A large aspirating needle was pushed into the cyst and a clear amber-colored fluid withdrawn. Aspirating needle being withdrawn, the cyst was emptied as far as possible through a large trocar and canula. The anterior cyst wall was incised widely and the cyst wall sewed to the skin. The remainder of the wound was closed by layer sutures around the opening of the cyst. The interior of cyst was then packed with gauze.

The first five days after operation the secretion was rather profuse, but the cyst contracted very quickly and was healed out completely on the day of his discharge, twenty-five days after the operation.

Report of Examination of Fluid from Pancreatic Cyst—Specific gravity, 1.021, color, golden-yellow (viscid), protein, 3.1 per cent, reaction, neutral, bile, negative, blood, positive, leucine, negative, tyrosine, negative.

Ferments Amylase, very active, lipase, negative, protease, negative.

Microscopic Many red cells, numerous leucocytes and debris.

FIBROMA OF STOMACH

DR HERMANN FISCHER presented a man, age forty-eight years, who was admitted September 2, 1923. His chief complaint was pain in the left hypochondrium, at first sharp in character, radiating to the precordium with no relationship to taking of food. Vomiting two to three hours after eating, vomitus being coffee-ground colored and foul tasting. He had noticed these symptoms the first time two months before entering the hospital. Patient has not been jaundiced. He is fairly well nourished. No previous illness. Has lost fifteen pounds in two months. Appetite is poor. No urinary symptoms. No gonorrhœa or lues. Family history negative. No masses can be felt in the abdomen. There is considerable muscular spasm and tenderness in the upper segment of the left rectus muscle. Right axillary and inguinal glands enlarged.

Stomach Contents P. C., color red-brown. Moderate amount of mucus, fluid with sediment, which is fairly well digested. Free HCl, 50. Total 64. Blood (guaiac test) positive. Microscopic. Starch granules, few red blood-cells.

X-ray Examination The roentgenograms reveal a constant defect involving both curvatures of the stomach in prepyloric area. The stomach empties normally within the six-hour period. The above findings indicate carcinoma of the prepyloric region.

Stool (Guaiac test), blood strongly positive, upon repeated examinations after meat-free diet.

Blood Hæmoglobin, 65 per cent, red blood-cells, 3,690,000, white blood-cells, 5200.

Operation—October 11, 1923. The stomach was easily delivered and on palpation a hard nodular tumor was found situated on the posterior wall near the lesser curvature. A resection of almost two-thirds of the stomach was done after Billroth I. A duodenal tube was inserted into the duodenum so that feedings could take place immediately after operation. Patient made an uneventful recovery and was discharged from the hospital two weeks after the operation. He now feels perfectly well and can eat most foods.

Pathological Examination Diagnosis, submucous fibroma of the stomach. Specimen consist of a large piece of stomach 14 cm long and 13 cm wide, varying from 1 to 2 cm in thickness. At one spot a round circumscribed growth is seen which measures 2 cm by 2 cm by 1.8 cm. Surrounding this growth there is an inflammation area, dark red in color, 4 cm by 7 cm. This area is slightly thickened and at one point a small, hardened nodule is found.

ARTHROPLASTY FOR ANKYLOSIS OF ELBOW

Microscopical Examination Section of the stomach tumor shows a circumscribed fibrous nodule which involves the mucosa and submucosa. A part of the surface is covered with atrophic mucous membrane, though the central part is bare of the epithelial covering and shows superficial ulceration. At the edges of the tumor the gastric mucosa is hypertrophic.

ARTHROPLASTY FOR ANKYLOSIS OF ELBOW

DR JAMES N WORCESTER presented a man twenty-five years of age, who was admitted to Reconstruction Hospital, May 9, 1922. In June of 1918, he received a gunshot wound of right elbow. Had several operations in France and in the United States for removal of sequestra and infection. Wound finally healed in August, 1921.

His elbow is now ankylosed at an angle of 90 degrees. No pronation or supination present. Considerable scar-tissue about elbow. X-ray showed complete fusion of humerus with both radius and ulna and fusion of head of radius with ulna. For a few days after his admission he was given intensive physiotherapy, in an attempt to stir up any latent infection. Nine months have now elapsed since complete healing of his wound.

Operation May 22, 1922. Arthroplasty right elbow, McAusland Horseshoe incision over the dorsal surface elbow, passing from one condyle to the other. A short linear incision was then made, beginning at the centre of the horseshoe incision and extending upward over the humerus for one inch. The soft tissues retracted over the olecranon process and with saw the olecranon with the tricipital attachment was divided, and then with chisel and hammer separated from the shaft of the ulna. The head of the radius, being fused with capitellum, required separate division. The olecranon process, fused to the coronoid fossa, was then separated with chisel and turned upwards. The condyles were then reshaped as was also the articular surface of the coronoid notch, the old one being considerably deepened into the cancellous bone. The head of the radius was somewhat shortened so that it would not prevent extension. All surfaces then smoothed off with file. A strip of fascia lata secured from the left thigh, was then sutured over the end of the humerus with several No. 2 interrupted chromic gut. The olecranon process was shortened so that part of the tricipital attachment extended over the end of the olecranon. The remains of the olecranon process were then sutured to the ulna with two heavy, kangaroo tendon sutures. Capsule closed with No. 2 chromic gut. The ulnar nerve which had been freed and lifted aside was then replaced subcutaneously, skin closed with silkworm gut and silk and arm immobilized with plaster splints. Thigh wound closed with silkworm and silk.

Following operation a hæmatoma developed which was evacuated through angle of wound. A mild infection followed. Two months later a small sequestra was removed and three months later another one. After this the sinus healed completely.

Immediately following the operation the arm was kept in a posterior moulded splint with elbow at right angles. Motion was started about the tenth day. The progress in this case was very slow, due presumably to the fact that immediate mobilization was not instituted after the operation. Five months after operation he had only 60 degrees range of motion. So under anæsthesia the elbow was stretched and motion encouraged. By persistent exercise this was increased to 120 degrees in the next six months.

Now he has an excellent result with almost complete flexion and extension. He is working as an electrician and while he still lacks power to lift heavy

weights, he says that his arm is very much more useful than before operation. He has no pronation or supination.

DOCTOR WORCESTER then presented a second patient, a man twenty-two years of age, who was admitted to Reconstruction Hospital, April 24, 1923, with an ankylosed left elbow. This elbow was fractured eleven years ago. Was operated on at Lebanon Hospital. Since that time elbow has been stiff. The elbow is ankylosed at 90 degrees angle. Pronation and supination very slightly limited. Skin and soft parts in good condition. Considerable bony thickening, especially in antecubital fossa. X-rays show absence of external condyle removed at previous operation. There is union between the humerus and ulna. Head of radius intact.

Operation May 2, 1923. Typical McAusland. Transverse posterior incision. Ulnar nerve retracted. Olecranon cut across with saw. Union of ulna and humerus cut across with chisel. Internal condyle of humerus removed. Coronoid fossa of ulna hollowed out, care being taken not to disturb head of radius or radio ulnar articulation. Lower end of humerus smoothed off and made to fit the head of radius and hollowed out ulna. A strip of fascia lata was taken and entirely freed of fat. This was placed over end of humerus and sutured anteriorly to anterior capsule of joint, as high up on anterior surface of humerus as possible. It was then tacked down posteriorly and laterally with interrupted chromic sutures. The divided olecranon process was united with two kangaroo tendon sutures and the lateral expansion of the triceps utilized to form the lateral portions of the new capsule, using chromic gut. Skin closed with silkworm and silk.

The arm was suspended with elbow at right angles and motion insisted on from start. Following operation there was considerable oozing and on the third day the wound was opened at one angle and a large hæmatoma evacuated. There ensued an infection of very mild degree which gradually cleared up. A sinus persisted until August 15, when it entirely healed. One month later a small fluctuating area appeared, and this was opened and several small sequestra appeared. Since then the sinus has closed and opened several times and it is evident now that other small sequestra are present, and if these do not extrude themselves very shortly they will be removed.

In spite of the infection the result is excellent. He has a complete range of motion. Pronation and supination are present and normal. His elbow is stable and he has good power and can lift a considerable weight.

DOCTOR WORCESTER, in reply to questions, said that as to the fate of the fascia he did not know what happened to it. In the first case he was sure that most of the fascia had come out. It had been a distinctly subacute infection with no bacteria and did not heal up until a lot of sloughs, which he thought were composed of fascia, came out. He believed that the fascia was responsible for the hæmatoma and long non-healing. He would be tempted in his next case not to use fascia but to make a joint-surface to fit well and then start with immediate motion. As far as lack of stability he had not seen an arthroplasty without instability. It does not bother the patients very much if they can perform the finer motions.

CARCINOMA OF TONGUE

DR FRANK S. MATHEWS presented a woman, who first came to him nine years ago, she is aged thirty-five, with a history of having had a lump of small size appear on the side of the tongue three months previously. It

TUBERCULOSIS OF BREAST

had been locally excised. When first seen nothing was demonstrable but the scar on the lateral margin of the tongue. Original sections of the growth were examined and pronounced epithelioma. In February 1915 a portion of the tongue was excised, including the scar, not going very wide of the scar on the dorsum of the tongue, but rather extensively excising the tissues in the floor of the mouth. At the same operation the glands down to the level of the larynx were removed through an incision under the chin. Patient has had no sign of recurrence and is in good health. Between the original local excision and Doctor Mathews' operation, patient was given one radium treatment by means of a radium tube placed in contact with the scar in the mouth. The tissue removed showed carcinoma in the scar. Radium effects were said to be recognizable microscopically. He called attention to the length of time that she has remained cured, and the fact that the usual etiological factors such as sex, bad teeth, tobacco habit, and leucoplakia, were all absent.

TUBERCULOSIS OF BREAST

DR FRANK S. MATHEWS presented a woman, forty-three years of age who gave the following history:

Two years previous to operation on the patient, she had brought in her child, aged nine months, who presented a small tumor over the parietal bone and a sinus at the ankle. The child was conspicuously healthy in appearance. The swelling over the parietal bone proved to be a cold abscess under the periosteum. Sections of the abscess wall and curettings from the ankle showed tuberculosis. The child had been brought up on the mother's breast milk.

Six months ago, the mother presented herself with a somewhat tender mass in the right breast, which seemed about the size of a hen's egg. The mass was fairly discrete, slightly tender, no nodes felt, nipple not retracted nor skin adherent. The tumor was rather large and lacked the usual characteristic symptoms of a carcinoma. After watching the tumor for three weeks without noting any change, it was operated upon and on incision of the tumor the impression given was that he was dealing with a carcinoma. A thick fluid, however, could be expressed from several portions of the mass. The usual operation for carcinoma of breast was undertaken, breast, axillary contents and muscle being removed. The pathologist's frozen section report was that there was no evidence of carcinoma. The final report was "granuloma of breast, probably tuberculosis of breast and axillary nodes." The impression was that the breast contained a small old tuberculous lesion to which a more recent acute inflammation had been added. The reason the pathologist did not make a positive diagnosis of tuberculosis was that no tubercle bacilli were identified in the sections. This would seem to be a case of primary tuberculosis of the breast, not secondary to gland or rib tuberculosis, in a patient who seemed otherwise quite well and who had no present or past history of lung involvement. The suspicion would be that the nursing's tuberculosis was derived from the mother's breast.

DR HUGH AUCHINCLOSS said that although cases of tuberculosis of the breast were not apparently so very uncommon, the source of the infection and its pathogenesis were still somewhat obscure. He cited three cases as having a bearing on the source of the infection. The first had already had multiple tuberculous foci the neck, axillæ and chest wall, all either operated on or discharging spontaneously. All had healed save one in the left axilla which had been discharging four years. Beneath the outer half of the

areola of the breast on the same side was a proven tuberculous abscess that when dissected out was found to be connected with the mass of tuberculous glands at the bottom of the axillary sinus. Most of the breast was saved in this case and the block dissection of the abscess, glands, axillary sinus and tissue intravening, resulted in a prompt clinical cure. The second case had had a discharging sinus just inside the areola of the right breast for almost a year. On excision of the abscess a sinus was found to extend to the sixth interspace close to the sternum where the cartilages are partially fused, and found to lead through the interspace into the anterior mediastinum where existed a small abscess, probably a broken-down lymph-gland along the internal mammary vessels. The third case was one of Doctor Dowd's at the General Memorial Hospital, some years ago. She had had tuberculous cervical glands removed previously. Both axillæ contained enlarged lymph-nodes at the time of operation for carcinoma of the right breast, outer hemisphere. Doctor Dowd removed the breast lesion first and subsequently did a radical mastectomy. Doctor Auchincloss found not only a very typical carcinoma of the breast in frozen section at the time, but, after making many subsequent sections of the axillary nodes, that no carcinoma cells could be found and they were simply riddled with discreet and conglomerate tubercles throughout. Some time later Dr. W. G. MacCallum happened to be looking at some large sections of the carcinoma from the breast and pointed out what appeared to be three tubercles actually in the margin of the carcinoma. He called attention to the fact that Doctor Mathews' case was associated with tuberculous axillary nodes, and it was Doctor Auchincloss' opinion that so-called primary tuberculosis of the breast probably does not occur at all, but that the disease enters the breast tissue by retrograde metastatic routes from tuberculous lymphatic tissue, the distributing point of which is often difficult to find, and that blood stream infection is difficult to prove and is probably very unusual. He considered the whole subject of the source of tuberculosis of the breast of great interest inasmuch as its routes of travel are the same as those taken by cancer cells, for both diseases, as is well known, diffuse so preeminently by the lymphatic routes.

DR. W. S. SCHLEY said that breast tuberculosis is a rare disease as compared with the malignant and benign growths, particularly the primary cases. A search of the available literature of the world showed but 120 cases up to 1910, scarcely more than twelve of these were undoubtedly primary in the breast, the rest being secondary to a tubercular process elsewhere. Bull, in 1894, analyzing 186 breast cases of his own, found but one case of tuberculosis. The history of mammary gland tuberculosis began in 1829 with Sir Astley Cooper's work on *Diseases of the Breast*. It was not until 1860 that the first case was proven microscopically, and not until 1881 that a case was proven bacteriologically, the present generally accepted method. The literature upon the subject is also scant compared with that upon other diseases of the breast. A few cases are added from time to time. The

RESECTION OF A SEGMENT OF THE CHEST WALL FOR CARCINOMA

disease occurs more often in breasts that have been functionally active but eight male cases were reported up to 1910. The oldest patient was seventy-three years of age, the youngest one year. The method of infection is still unknown but it is probably through the blood stream, at least in the primary cases. Direct extension through contiguity occurs not infrequently, from a carious rib, from the periosteum or from the pleura. Tubercular axillary glands have apparently produced a retrograde infection, although it is difficult with involvement of the breast simultaneously to say which occurred first, as a small focus of disease in the breast may produce enlarged and suppurating glands in the axilla. Doctor Schley said that his own case of primary breast tuberculosis, reported in 1903, had no involved axillary lymphatics and a tuberculin test made later gave a negative result. In the primary cases, the apparent good health of the patient has been frequently noted in the literature and this was true in the speaker's case and appeared true in Doctor Mathews' case. There are various forms of the disease, single nodular, multiple nodular, confluent, and disseminated, all tend toward breaking down and abscess formation with the consequent development of fistulae and sinuses. Few are diagnosed before operation. The best treatment is amputation with the clearing out of the axilla. The primary cases have a good prognosis, the secondary cases depend upon the degree and extent of the tubercular process elsewhere.

TRAUMATIC STRICTURE OF SMALL INTESTINE

DR FRANK S. MATHEWS presented a child, aged four and one-half years, who was injured by an automobile four months ago, sustaining abdominal and head injuries. Recently the child has had attacks of pain with visible peristalsis and much distended intestinal coils. X-ray following bismuth meal showed fairly prompt elimination, distended coils of gut were always visible. Bismuth injection showed that the obstruction was not located in the large intestine. Operation revealed a stricture in the middle of the small intestine, with enormously dilated and thickened intestinal wall above the point of constriction. The intestine seemed to angulate at this point and was also covered with adhesions. A resection was done, ends closed, and side-to-side anastomosis made. Microscopic examination showed a distinct defect in the muscular wall of the gut which was replaced by fibrous tissue. The injury then would seem to have been one which divided the thickness of the muscular coat without perforating the mucous membrane. In the healing process, this narrowed the lumen and also caused angulation. The child developed a fecal fistula post-operatively.

RESECTION OF A SEGMENT OF THE CHEST WALL FOR CARCINOMA

DR GEORGE H. SEMKEN presented a woman, now aged fifty-seven years, who came under observation in September, 1918, because of a large carcinoma of the left breast, 7.0 cm. in diameter, situated in the outer half between the radii 1.30 and 6.00 o'clock. The tumor was rounded and of stony hard consistency. The nipple was not retracted, there was no fixation to the skin.

or change in its color and the tumor seemed movable upon the deeper structures. The axillary lymph-nodes were large, and there were also palpable, enlarged nodes in the supraclavicular space. Physical examination otherwise was negative.

The duration of the tumor was about one and one-half years, and there had never been any subjective symptoms. The diagnosis of carcinoma had not been made by her medical attendant and she had therefore, had no treatment during the entire period excepting some internal medication. The family history was negative for cancer. She had been married for nineteen years, but had never been pregnant. Menstruation still continued normally. There had never been any known inflammatory process in the breast, and the only possible etiologic factor that could be discovered, was a trauma through the impact of a baseball upon the breast.

On September 13, 1918, the combined radical breast and neck operation was performed. Colonic ether anæsthesia was effective and well borne. The breast operation followed the technic of Willy Meyer, with the additional epigastric dissection suggested by Handley. The breast and its overlying skin were removed, together with the pectoral muscles, axillary fat and lymphatics, the anterior and inner parts of the sheath of the axillary vein, the subscapular fat and lymphatics, the fascia over the serratus, and the epigastric fat with parts of the upper, anterior rectus sheath of both sides. Closure was effected with suture and a small primary Thiersch graft. The neck dissection was done *via* the incision of DeQuervain, running along the sternocleidomastoid line from the middle of the neck downward, and then curving back at and along the clavicle to the edge of the trapezius. The triangular flap of skin and subcutaneous fat was reflected, the sheath of the sternocleidomastoid muscle was incised, as was also the insertion of the outer layer of the middle cervical fascia along the clavicle, the sternocleidomastoid muscle was drawn forward, and the sheath of the internal jugular vein was incised, first on its anterior surface, and then, after liberation from the vein, along its posterior surface also. With this preparation, it was possible to extirpate the supraclavicular lymphatics radically within the two layers of the middle cervical fascia. The superficial cutaneous nerves, the external jugular vein, and the omohyoid muscle had to be divided. Wound closure was done with sutures, split rubber tube drainage being provided through a small stab wound in the posterior line. Recovery was uneventful, and the patient was able to leave the hospital, with the wounds wholly healed, fifteen days later. The microscopic examination of the excised tissue showed a schirrus carcinoma in the breast and carcinoma in the axillary nodes. Carcinoma was not found in the cervical nodes, but since no extended search was made, and the node involvement was unusually extensive for a case presenting no ulceration, the case was regarded as an early cervical node cancer involvement also.

The patient remained well for one year, then several small nodules were noted in the skin and subcutaneous tissue above and below the site of the Thiersch graft. On September 16, 1919, an area of skin 15 cm by 9 cm in size, containing the Thiersch graft and all the discoverable nodules, was removed, and with it, the underlying subcutaneous fat and the fascia over the intercostal muscles. Closure was effected by making a new incision parallel to the lower wound margin and well below it in the upper abdominal region, undermining the flap so outlined but leaving it attached at each end, and sliding this up in bow fashion, to cover the chest wound. The resultant defect at the flap site was covered with Thiersch grafts after the area had

been narrowed by drawing in and "tacking down" the lowest margin with sutures. Recovery again was prompt and uneventful.

The second recurrence was noted on March 7, 1921, as a nodule with slight erosion just above the upper line of the flap from the second operation and behind the vertical scar line from the first operation. Under this nodule was a tumor extension down to the rib and intercostal muscles extending above and below the transverse scar line. The third operation was done on March 19, 1921. Under the colonic ether anesthesia of Gwathmey, which was very well borne, a segment of the chest wall consisting of parts of the fourth, fifth, sixth, and seventh ribs and containing the new growth with a wide area of healthy skin, the intercostal muscles and the parietal pleura under the central half of the segment, was excised. The opening of the chest cavity caused no respiratory embarrassment and the pulse rate, which had been 72, rose to 84, to return again to 72 after a few minutes. The lung did not wholly collapse. Closure of the wound was effected by means of a sliding flap from below, with a single pedicle posteriorly, made by again cutting the lower margin of the flap made at the previous operation, and also incising it anteriorly, then liberating it from the underlying tissues and sliding it upward into the gap. The wound surface thus left on the lower chest wall was covered with Thiersch grafts. No drainage was employed. Convalescence was uneventful, there was no cough, and no fluid was noted in the pleural cavity. Healing was by first intention, and the patient left the hospital nineteen days after the operation.

In October, 1921, some small subcutaneous nodules appeared at the upper scar line of the flap, and while none was excised for diagnosis, it was deemed advisable to treat these with the X-ray. This was done under the supervision of Dr. Francis C. Wood, and the nodules have disappeared. The patient is now apparently well and has no discomfort of any kind. The bony defect in the chest wall is visible only when she coughs or makes other forcible chest movements. She has full function also, in the arm.

DR. NATHAN W. GREEN expressed his belief that this case was a signally successful one and should not go undiscussed. The fact that the patient was alive and apparently cancer free at the end of five years in itself was worthy of attention. What Doctor Semken had done had been attempted by other physio-therapists by repeated attempts at destruction or controlling of cancer cells, or at increasing the resistance of the organism to invasion by the use of radium or by deep radiotherapy. This was still *sub judice*. But to date the best proven therapy was thorough and early surgery. An interesting point about this case was, that while Doctor Semken resected the chest wall and opened the pleura widely, there was no apparent shock nor any disturbance of the pulse or respiration. This could not always be looked for. At a meeting of a group of men, especially interested in thoracic surgery two years ago in Boston, it was held by a large part of the members present that some means for artificial respiration should be ready at hand in all cases when the free pleura was to be widely opened. He had no doubt that Doctor Semken took the precaution to have at hand some simple apparatus for inducing artificial respiration in this case.

DR. W. S. SCHLRY said that the case suggested two facts: first, that one need not always be discouraged in the face of recurrence, and second, that

carcinoma is sometimes an erratic disease. A local recurrence, or one in the supraclavicular glands, may be the only extension of the disease, and after careful examination it is often justifiable and proper to operate on these cases, as they sometimes wait for years without further evidence of the disease and die of other affections. Carcinoma of the breast in some cases appears to remain a local disease for long periods, contrary to its usual custom. A case of Doctor Schley's recurred and was operated on by him thirteen years after the primary operation. The recurrence was a single flat nodule in the lower end of the scar, there were no demonstrable metastases elsewhere. A second recurrence in the scar was also a second case, seen two or three years ago, and had been operated on twenty-six years before. She presented multiple nodules about and in the cicatrix on the chest as though operation had been done a year or two previously. There were no other demonstrable involvements at that time, although no X-ray of bones was made. This patient appeared to die of inanition without definite involvement of any organ, but general infection must have occurred. Another case recurred at the end of nine years in the supraclavicular glands and, after operation, remained well for over a year until lost sight of. Doctor Schley said that he had operated on a case similar to that of Doctor Semken, removing parts of two or more ribs for persisting local recurrences. The disease finally invaded the lung, which had become attached to the chest wall and, on the last operation, some of the lung was removed. She had had a number of X-ray treatments. This patient's disease apparently never metastasized widely but remained a local affair. She lived eight years after operation, but had been lost sight of the last year or so, although Doctor Schley had heard she lived a total of twelve years.

DOCTOR SEMKEN, in closing the discussion, said that the suggestion of Doctor Green, that the opening of the chest cavity might at times give rise to severe respiratory embarrassment, was timely. In this instance, the Meltzer-Auer apparatus had been in readiness for immediate use if required. In another similar case of resection of part of the chest wall for localized, recurrent cancer, the wide opening of the pleura caused no respiratory disturbance whatever, while in a recent case of intrathoracic, extrapleural neurofibroma, at the costo-vertebral angle, the accidental tearing of the pleura over about one inch, caused considerable difficulty in breathing and cyanosis. This patient was lying on his side, while the other two were lying supine, but this probably does not explain the difference in the respiratory reaction.

The question of the possibility of cure in cases of cancer of the breast with both axillary and supraclavicular lymph-node involvement was denied by Cheyne, but has been proved by the successful cases published by Halsted. Cheyne believes that involvement of the nodes along the subclavian vein meant involvement along the innominate also, but the lymphatic tract of this region ends in the subclavian lymph trunk, which enters either the right lymphatic or the thoracic duct in the lower neck, and this field seems to follow the

CICATRIX-DEFORMITY OF DORSUM OF HAND AND FINGERS

experience of cancer localization shown in other node groups. The weak spot surgically is the region under the clavicle, and the best procedure would therefore seem to be the combined neck and chest operation in one stage so that the junction of the two operation fields, under the clavicle, can be clearly determined. It is a desirable procedure, in all radical breast operations to mark the axillary tissue during its removal, with black silk marking threads one thread marking the tissue from the highest point reached on the axillary vein, and two threads marking the region about the subscapular vessels (the lowest point on the axillary vein). If the laboratory report upon the tissue shows carcinoma in the nodes at or near the highest point of the dissection, a cancer involvement of the supraclavicular nodes may be presumed, and the neck dissection should follow without needless delay.

CICATRIX-DEFORMITY OF DORSUM OF HAND AND FINGERS

DOCTOR SEMKIN presented a man, now aged twenty-six years, who was injured in the bomb-explosion in Wall Street, in 1920, and among his injuries, sustained severe burns to the dorsum of both hands the left being the more severely injured. The resultant cicatrices become keloidal almost immediately after the healing was completed, and he then received treatment with radium and the X-ray from November, 1920, to February, 1922. When he came under observation on September 7, 1922, the condition of his left hand (which is the subject of the present report) was as follows. The skin of the whole dorsum of the hand, the dorsum of the base of the thumb and fifth finger, and the whole dorsum of the second, third, and fourth fingers was thin and cicatricial. The burn destruction had evidently not gone below the skin, but, in consequence of the radiation treatment, there was marked atrophy of the skin, with telangiectasis, and occasional crust formation over superficial radium ulcers, especially on the fingers. There was rigidity in the finger covering, and contractures had developed at the site of the webbing between the fingers.

The procedure in this case was the excision of the cicatrized skin and its replacement with a flap from the lower, lateral chest wall. On November 28, 1922, under general anaesthesia and with Esmarch ischaemia, the skin and subcutaneous tissue of the dorsum of the left hand was removed, from the wrist down the hand, the line of section ending at the base of the thumb, the distal end of the second phalanges of the index middle, and ring fingers, and the middle of the second phalanx of the fifth finger. All the fine spider-web cicatricial strands over the tendon sheaths were removed. The Esmarch bandage was then removed and ligature haemostasis was completed. The wound was temporarily covered with gauze moistened with saline solution. Then, a suitably shaped, relatively quadrilateral flap of skin and subcutaneous tissue was prepared on the lower right lateral chest wall, where (1) the skin and fat were thinnest, and (2) where the left hand could be placed without discomfort to the patient. This flap was elevated from above down, leaving the pedicle along the lower border, and the resultant defect was immediately closed partly by drawing in the edges and suturing these (with the assistance of small supplemental relaxing incisions), and by covering the remainder of the wound with broad Thiersch grafts which were made to cover the raw surface of the pedicle also. A small sterile dressing was applied over this area, firmly fixed with numerous sterile adhesive plaster strips to guard against displacing the grafts, the left hand was then placed over this with

the palm flat against the dressing, and the flap was placed *in situ* and sutured upon the dorsum of the hand, the pedicle coming into relation with the ulnar margin of the hand. Thus the flap covered the dorsum of the hand in a broad, blanket-like manner, giving it the appearance of a duck's webbed foot, for separation of the finger flaps at this time would have cut off the nutrition of those parts. The fingers were separated widely with gauze pads, to allow for the maximum of new finger skin in the bridges between the fingers, and small Thiersch grafts were placed upon the raw flap surfaces between the fingers, to favor early healing. Gauze pads were interposed between the arm and the chest to prevent dermatitis from skin contact, and fixation of the arm was effected with a plaster-of-Paris case. The sutures were removed eight and ten days later, through a window cut in the case. The case was removed and the pedicle was divided, seventeen days after the operation, and four days later, under local anæsthesia, the ulnar border of the flap (previously the pedicle), was prepared and sutured to the ulnar margin of the palm, and the stump of the pedicle was reimplanted in the chest wall. Healing had been complete except at a small part of the angle at the base of the thumb, and this soon healed by granulation.

On January 9, 1923, six weeks after the operation, the fingers were separated by cutting the web of flap tissue between them, removing the excess fat at the edges, and sewing these to newly cut wound margins on the normal finger skin. At this time also, the excess of subcutaneous fat in the flap tissue of the fingers was excised from the section over the first phalanx of the index, middle, and ring fingers, and a revision scar-excision and suture was done at the base of the thumb, but no attempt was made then, to restore the normal finger-webbing.

The final procedure was carried out September 21, 1923. The excess of subcutaneous fat under the tips of the finger-flap tissue (over the second phalanges) was excised, and the thin skin flaps were again sutured in place, and the webs between the fingers were restored by Agnew's technic. This consisted in cutting a triangular flap in the tissue of the dorsum, over the site of the web, with its apex distal and its base at the knuckles. This flap was then raised, the remaining tissue between the fingers was incised well up into interdigital angle, and the excess of fat in this part was removed. Finally, the triangular flap was drawn down between the fingers, its apex meeting the palm, and it was sewed in place with fine silk. The lateral finger wounds could also be closed with sutures, although usually, it has been necessary to close these with small Thiersch grafts. The final result is satisfactory. He has a normal skin and fat covering for the hand and fingers, capable of being stretched and of withstanding the cold, and sensation has returned to a considerable degree. A similar procedure will be carried out with the right hand in the near future.

RHINOPLASTY FOR EXTENSIVE EPITHELIOMA OF NOSF

DR GEORGE H. SIMKEN presented a man, now aged sixty-eight years, who noted a small lesion on the left ala of the nose about eight years ago. It received no treatment for a few years, owing to the patient's negligence, but its progress was slow. His subsequent history was the usual story of incomplete surgery, a number of X-ray "cures," and then a combination of these, until in June, 1923, when he came under observation, he had an advanced cancer of the nose involving the lower two-thirds of the right side, the adjacent portion of the left side at the midline, the upper septum, the

floor of the right nostril, and the adjacent part of the right cheek. The ala had been completely destroyed.

On June 14, 1923, under colonic ether anaesthesia, the cancerous tissue and a wide margin of healthy tissue were excised. This involved the removal of the major part of the right side of the nose, including the corresponding part of the right nasal bone, about one-fourth of the mesial part of the left side of the nose, the upper third of the septum, the floor of the right nostril, and a part of the right cheek. As a preliminary step, the surface of the lesion had been cauterized with a Pacquelin cautery to prevent implantation of cancer tissue during the operation. The large defect thus produced was covered with a pedicled flap from the right half of the forehead, suitably shaped, its pedicle being at the nasofrontal region. The raw surface of the flap within the nostril space was covered with a Thiersch graft, as was also the defect in the nasal floor. The defect on the forehead was similarly covered with a broad Thiersch graft, the wound edges being left uncovered, (1) to prevent elevation of the graft by later bleeding from these edges, and (2) to favor a better cosmetic result through the drawing down and flattening of the skin margin by contraction of the edge scar-tissue. A ring of iodoform gauze was laid around the graft to cover the raw edges of the forehead wound. Prompt healing followed, and two weeks later, on June 28, the pedicle was divided, the upper flap edge was sutured in place, and the pedicle stump was returned to its original forehead position, after excision of the necessary amount of the recently placed Thiersch graft at that site.

This brought the case into the usual completed stage of unilateral rhinoplasty for cancer, but two problems remained for solution, (1) the need to keep the new ala well shaped, and (2) the need to prevent nasal stenosis through contraction under the Thiersch grafts, and through shortening and broadening of the new ala. As a first step in meeting these indications, it was necessary to replace the lost alar cartilage with another, and this was obtained from the concha of the right ear. On July 12, 1923, under local anaesthesia an incision about one-half inch in length was made at the outer end of the alar portion of the nasal flap. From this wound, a sharp-pointed knife was made to cut a subcutaneous tunnel in the flap, to the nasal tip, as a site for the cartilage implant. Bleeding was checked by manual pressure over gauze pads so that no clots could form in the wound. A curved incision was next made on the posterior surface of the ear, just distal to the sulcus at the mastoid junction. The skin was reflected on both sides of the incision, and the cartilage was freely exposed. A triangle of cartilage with perichondrium on the posterior surface was removed from the bowl-shaped concha, its base being at the outer end and its apex toward the auditory canal, and the incision in the skin of the ear was closed with silk sutures. The cartilage thus obtained was then inserted into the subcutaneous tunnel in the alar part of the flap, through the marginal nasal wound, compression was exerted for a few minutes, for hæmostasis, and the small nasal wound was closed with sutures. This implant healed without visible reaction, and an interval of a few months was allowed to elapse before the second procedure was carried out.

As had been expected, contraction occurred in this time, the ala had taken on a bulbous appearance, and the right nostril was merely a small slit. To overcome this condition, two small procedures were necessary, and these were carried out under local anaesthesia, on October 2, 1923. First a quadrilateral flap of skin with a minimum of fat was cut from the broad alar edge, its base at the floor of the nose, and second, an incision was made in the remaining alar margin, along the thickened edge, the skin margins

were raised, and the excess of fat was removed, making the ala as thin as was deemed safe. Then the deeper part of the flap attachment to the floor of the nose was incised, to open the nostril freely, and the quadrilateral skin flap was laid down upon this raw floor-surface, to which it was held in apposition by a firm gauze packing. Finally, the margins of the alar edge incision was sutured, and only a small wound remained at the outer edge of the ala, for healing by granulation (it being expected that the skin would be drawn around by the contraction). Gauze-wrapped rubber tubing was used in the beginning to keep the nostril well opened, and this was later replaced with a shortened Kernon nasal splint of hard rubber. The final result is a presentable nose, with firm ala and an open nostril. The forehead graft is not conspicuous, and there is no visible deformity in the ear.

MARGINAL JEJUNAL ULCER

DR JOHN F ERDMANN presented a man upon whom Doctor Schley had done a gastro-enterostomy eleven years ago. For a period of six years thereafter he felt perfectly well, gaining in weight, etc. For the past five years he has been complaining of very much the same type of symptoms he did before operation, with an increased manifestation of pain and increased symptoms, practically unbearable during the past three months. He presented a picture of marked anæmia, stooping posture, inability to walk and suffering agony. There had been some vomiting. He recently had been X-rayed with negative findings. His pain extended downwards to the left, and he had pain on pressure immediately to the left of the median line of the epigastrium. The man was kept two days on Murphy drip and then operated upon with the following findings. A large ulcer, fully an inch in diameter, between the stomach and the jejunum which was perforated at the proximal loop of the jejunum. The transverse colon was densely bound down to this ulcer at the margin of the former anastomosis, an obstruction at the pylorus due to an old ulcer. A complete revision of his gastro-enterostomy was done by closing the stoma in the stomach, doing an end-to-end anastomosis in the jejunum separating the colon from the margin of the gastro-enterostomy, removing his gall-bladder and appendix, and doing a Horsley at the pyloric end. He has gained thirty pounds.

DR W S SCHLEY said that he had operated on the patient in 1912, at which time there was an enormous infiltration of the pyloric area and very general adhesions about this end of the stomach, probably benign, so that nothing else could be done but a gastro-enterostomy, after which he was well for nearly six years. He had written this fall that he was ill again and arrangements were made for him to go to the hospital, but he got frightened and left before operation. Doctor Schley had not known what became of him after that until to-night. It was interesting to note that a long tracing of stomach operative work was necessary if one were to arrive at definite knowledge of the value of one's operative procedures. Some ulcer cases would do badly regardless of the operative procedure and care in technic.

SEQUELÆ OF EPIPHYSEAL LINE INJURY

DR MORRIS K SMITH presented two cases with the following histories.

CASE I.—T B, suffered an epiphyseal separation of the lower end of the radius four years ago, when seventeen years of age. The displacement was reduced under anæsthesia. The immediate result was good. Eight months

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later he returned complaining of weakness of the wrist and prominence of the end of the ulna. At this time ossification was largely completed in the injured epiphyseal line. At the end of a year it was complete. At present there is shortening of the radius of three-quarters of an inch. The function is good, but a permanent deformity remains.

CASE II. E. M., at the age of thirteen suffered a vertical fracture through the lower epiphysis of the tibia into the epiphyseal line at its inner end. Eleven months after it was noted that the external malleolus was prominent and that the tibia was three-eighths inch shorter than that of the uninjured side. Premature ossification had not evacuated at the time the last X-ray was taken one year and nine months after injury. At present, over two years after injury, the boy has five-eighths inch shortening of his tibia which he compensates by tilting the pelvis. The fibula is not shortened, the result being that the external malleolus is prominent and nearer the sole of the foot on the injured side. He is working as an errand boy without disability.

THE PROGNOSIS IN EPIPHYSEAL LINE FRACTURES

DR. MORRIS K. SMITH read a paper with the above title, for which see page 273. *ANNALS OF SURGERY*, February, 1924.

DR. JAMES MORLEY HITZROT called attention to Doctor Smith's observation that there was very little difference in the result when a portion of the diaphysis came away with the epiphysis. In his (Doctor Hitzrot's) experience this variety was less likely to produce disturbance in growth, than those injuries confined to the conjugal cartilage alone. One should be careful of the prognosis. He once had a case where there was very little displacement of the lower radial epiphysis in which he sent the X-ray picture to the patient's father, who was a physician, to show the good result. There is now quite a deformity due to premature ossification, for which Doctor Hitzrot is considered responsible.

Doctor Hitzrot showed the X-ray film of the result of a separation of the lower right femoral epiphysis nine years after injury. The case was recently referred to him by Doctor J. H. Cudmore with the history of an injury to the right femoral epiphysis, when the boy was not quite nine years old. This was apparently perfectly reduced at that time. About six months after the injury it was noticed that the leg was not as long as its opposite and not as well developed. This difference in length has been steadily increasing. The boy is now not quite eighteen years old and the difference in length is two and one-half inches plus. The X-ray shows very beautifully a premature ossification of the lower femoral epiphysis with a lack of growth in the bone, both in the longitudinal and in the transverse plane.

The cases of femoral epiphyseal separation are not common but they are bad cases and make an impression out of proportion to their number, and the ultimate result when premature ossification occurs is very distressing to the patient.

DR. RICHARD W. BOLLING expressed his belief that the natural tendency to correction of deformity should be considered, especially when the question of treatment comes up in cases of epiphyseal separation seen late, or when

only incomplete reduction has been obtained. A case in point was that of a child of eight years, seen sixteen months ago with a history of injury to the knee four weeks previously. A roentgenogram showed a partial dislocation backward of the lower femoral epiphysis. In view of the fact that union had advanced, no attempt was made to correct the deformity but the knee was immobilized for five weeks and the patient discharged in nine weeks. At the end of eight months there was perfect function and the normal contour of the femur had been restored.

Stated Meeting Held December 12, 1923

The President, DR. EUGENE H. POOL, in the Chair

BONE PEGGED FRACTURES OF NECK OF FEMUR

DR. EDWIN BEER presented four patients with fractures of the neck of the femur in which a bone peg had been introduced about four years ago under spinal anaesthesia.

The four cases presented were operated upon by Dr. George Cahill and Dr. Edwin Beer about four years ago. They were not shown with the object of stimulating operative treatment of this type of injury, but with the object of presenting average end results following operative treatment. The cases were done to really see what operative treatment would accomplish, and he was free to confess that although all four patients had useful, serviceable limbs, an ideal functional result was not obtained. Ideal functional results are claimed by the enthusiasts for all types of treatment, whether the enthusiasts followed the Whitman abduction treatment, or whether they followed the abduction treatment with forceful impaction of the fragments as advocated by Cotton, as well as when bone-pegging has been used.

CASE I—(Fig 1) Joseph Parker, age fifty-two, was admitted September 2, 1919, with a fracture of the neck of left femur (non-impacted), complicated by diabetes. At the end of three weeks a bone peg from tibia was introduced into the fractured neck of femur under spinal anaesthesia, neck being exposed through an anterior incision and the drill being introduced through a lateral incision through base of trochanter and driven into head of bone. Excess material of bone peg was broken up into small fragments and these were introduced into fractured area as well as about same. Patient was placed in moderate abduction in plaster for ten weeks. Thereafter patient wore brace to April 20, 1920. Then used crutches to May 15, 1920, and thereafter used cane.

When last seen on October 19, 1923, he had a limp. Shortening is between one-half to three-quarters inches. Walks without cane and can stand with full weight, 200 pounds plus, on broken leg. Flexion at hip is to almost 90 degrees. Internal and external rotation almost complete. Abduction to approximately 30 degrees. X-ray this date (Fig 1) shows bone peg is still visible—four years after operation.

CASE II—(Fig 2) Benjamin Williams, age fifty, was admitted October 28, 1919, with a non-impacted fracture of the neck of femur. Under spinal anaesthesia a bone peg was inserted November 13, 1919, as in Case I. The bone peg was very thin, the cortex of the tibia being unusually thin. Leg put

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up in moderate abduction, proper position having been determined, as in previous case, when fractured surface was exposed

January 28, 1920 X-ray showed considerable bone formation and a fracture of the bone peg Patient developed peripheral neuritis in both arms, which delayed the use of crutches

October 18, 1923 X-ray (Fig 2) shows bone peg still visible There is considerable new bone formation in and about region of injury The man

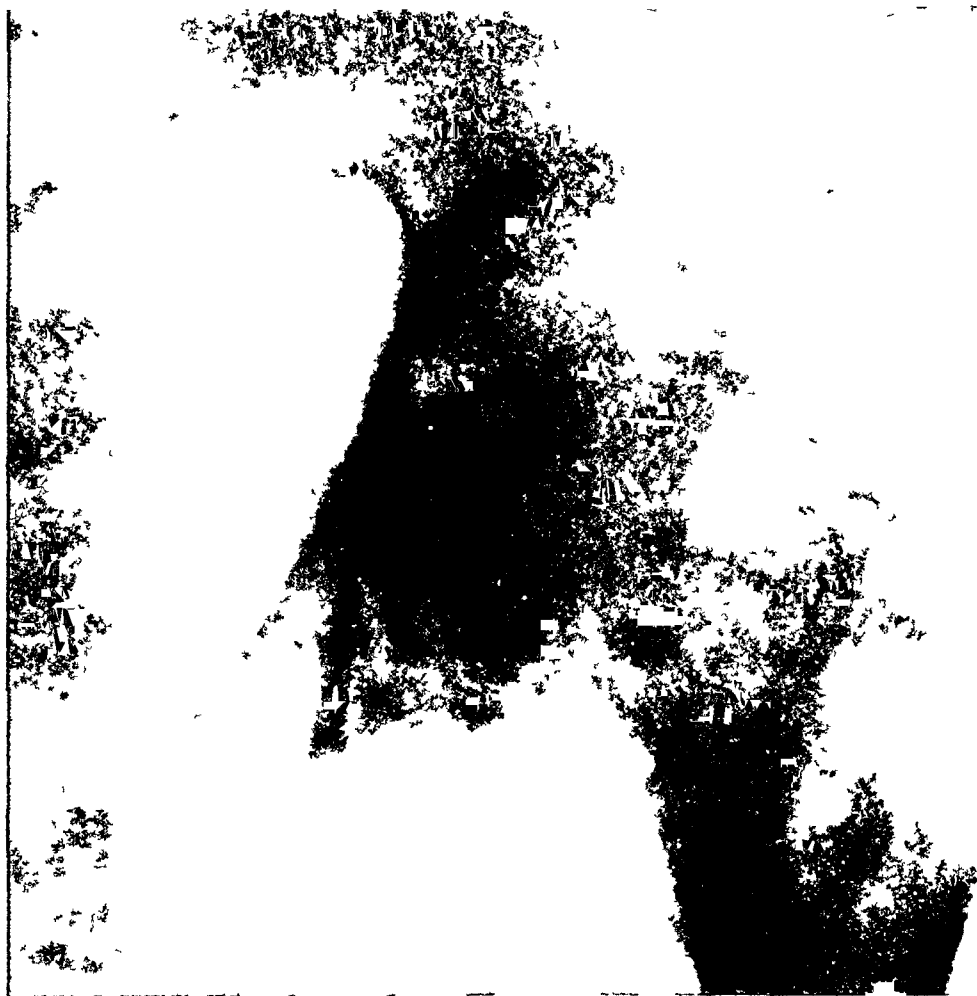


FIG 1—Case I

walks readily eight to nine blocks, never more than a half mile at a time, as hip gets sore if he walks too much Flexion at hip is to almost 90 degrees Internal and external rotation at hip are good but abduction is lost, though the neck of the bone as seen in X-ray (Fig 2) is fairly satisfactory the small fragment of bone placed about the fragments, together with the broken peg which allowed of some angulation, have prevented the retention of good abduction

CASE III (Fig 3) Mrs Mary O'Brien, age fifty-eight, was admitted November 2, 1920, with a non-impacted fracture of the neck of left femur On the following day, under spinal anaesthesia, the neck of the femur was pegged as in the previous cases, and put up in moderate abduction Patient also made an uneventful recovery

October 18 1923 Patient reexamined Uses cane on streets Has occasional pain Motion at hip is good Flexion, extension and rotation

at hip are good but abduction is very slight owing to extensive bone formation in fragments placed about neck of femur at time of operation, very much the same picture being produced as in Case II

CASE IV (Fig 4) Mrs Agnes Goodwin, age thirty-six was admitted March 29, 1919 with a non-impacted fracture of the neck of the right femur. She was treated for almost nine months with a plaster case in abduction. The treatment did not lead to any union. January 8, 1920, under spinal anaesthesia



FIG 2 —Case II

with a small amount of ether a bone peg was introduced as in the three previous cases and the limb put up in plaster-of-Paris which was maintained for about three months. It was interesting to note that as a result of attempts at moving the broken leg there had been almost complete absorption of the upper part of the neck so that at operation the upper fragment in addition to the head presented very little more than a shell of bone at the inferior aspect of the neck. This cavity was filled with bone fragments derived from excess material of the bone peg. After removing the case, as in the previous cases, the patient was encouraged to exercise while lying in bed. Gradually she began walking, first using crutches then cane, and was at last allowed to bear her full weight on the broken hip six to nine months after operation.

October 23 1923 Despite marked absorption of bone encountered at operation patient has excellent functional result. She can walk without cane has no pain, none or very little shortening though there is a slight limp

BONE PEGGED FRACTURES OF NECK OF FEMUR

Flexion is complete and abduction good. The X-ray of this date (Fig 4) shows very fair result with bone peg still in place and well-marked lines of calcification running down from head into shaft.

DR ROYAL WHITMAN said that at the time of the introduction of the abduction treatment it was the established belief, that fracture of the neck of the femur was an exception to all others, in that its treatment on surgical



FIG 3—Case III

principles was both futile and hazardous. If it were intracapsular non-union was inevitable, if impacted the deformity must be protected regardless of its effect on function. In short, to quote from a modern treatise on fractures, "the ideal object of treatment, restoration of form and function, was rarely to be attempted or even sought." The results have been so extraordinarily bad that they have served to uphold the theory and practise that produced them, thus forming a homogeneous interdependent structure, that like the wonderful one-horse shay couldn't break down because it had no weakest part. "For the back crossbar was as strong as the fore and the whipple tree neither less nor more."

The actual basis of this belief and teaching has been the inadequacy of conventional methods to provide the opportunity for functional repair. For

since the neck of the femur projects laterally from the shaft, splinting and traction can at best appose the fragments only in a lateral and therefore insecure relation

The abduction method utilizing the mechanics of the joint enables one to correct deformity and to adjust displaced fragments, consequently surgical principles have been applied, regardless of the rules of practise adapted to



FIG 4—Case IV

inadequacy, and the practical experience of the past twenty years has disproved all the conclusions on which they are based. Union is possible and probable in any form of fracture regardless of the age of the patient, if the opportunity is assured. The immediate correction of deformity does not endanger repair, but favors it by apposing the fractured surfaces. The treatment of the fracture as a fracture does not endanger life. On the contrary, it is far more conservative than life-saving neglect. In short, it has been demonstrated that fracture of the neck of the femur differs from other fractures only in the sense that it stands first in the therapeutic scale, as the fracture which because of the greater physical, mechanical and nutritive obstacles to success that it presents, is on this account the fracture in which the result is most directly determined by the efficiency of the treatment. A

BONE PEGGED FRACTURES OF NECK OF FEMUR

method is now available by which the opportunity for repair may be attained and physically demonstrated and for this primary essential of success the one who undertakes the treatment of the most disabling of all fractures may now be held responsible. In other words, conventional authority can no longer assure immunity for incompetence and neglect.

DR H. H. M. LYLI said that he had no personal experience with the bone-peg treatment of fracture of the neck of the femur, but he could conceive that this method might have a narrow field of application. It had been his practice to employ the Whitman abduction method in the treatment of fractures of the neck of the femur since it was first introduced into St. Luke's Hospital by the late Dr. Francis Markoe. In this time there had only been two failures and strange to say these had occurred within the last three years. Both of these failures were not caused by the method, but by faults in the after-treatment. One was a refracture due to the fact that while the patient was still on a walking brace the attendant, without orders, removed the perineal support thus bringing the full weight on the recently united fracture. The second failure was in a case of an associate, afterwards this case had a reconstructive operation performed by Doctor Whitman.

DOCTOR WHITMAN said that it was apparent in all the Rontgen pictures of Doctor Beer's cases that the angle of the bone peg on the trochanteric side of the fracture did not correspond with that of the inner fragment, indicating that it had either been broken or absorbed during the process of repair, thus permitting a depression of the neck and consequent limitation of abduction. The retention of a fair range of abduction was only secondary in importance to the attainment of union. The ability to separate the limbs symmetrically was the first essential of stability if the base were uneven or insecure, and it was also essential for a normal gait as illustrated by the patients presented, the marked limp being explained in great part by the loss of this range and by the compensatory tilting of the pelvis. Doctor Whitman believed that the field for bone pegging either primary or secondary, was very small. The cases in which it was performed were always of a favorable type, a class in which natural repair was the rule if the opportunity were assured by efficient treatment.

As evidence bearing on the question of natural repair, he would accept only an X-ray picture taken through the plaster after the application of the abduction treatment showing apposition of the fragments in normal relation. If under such conditions union had failed, he would consider the outcome of secondary bone pegging so uncertain that he would advise a reconstruction operation, more especially as the functional results of this procedure may be compared not unfavorably with the cases presented.

DR EDWIN BEER, in answer to a question, stated that the four cases presented by him were in bed in plaster from eight to ten weeks, then for two weeks longer in bed without plaster, and after three months or thereabouts, the patients began to move about on crutches, the two males having a steel brace

The functional result in the late ununited fracture (Case IV) appeared to Doctor Beer to be the best result in this series, although he was free to admit that not one of the four cases had as perfect a result as the literature on bone pegging suggested as the usual outcome. The fact that abduction was limited or almost absent in two of the cases was readily explained, in part at least, by the fact that the fragments of bone placed at operation about the neck of the femur, undoubtedly, produced a certain amount of new bone which blocks abduction. In addition, as the X-rays in these two cases show, the angle of the neck has been markedly changed in the sense of coxa vara, perhaps by too early weight-bearing which began in three of the cases in the fourth month. Although Doctor Beer was not advocating operation as a routine procedure in these cases, as many of these patients were much too old for operative interference even under spinal anæsthesia, he felt that early rapid union with weight-bearing power and fair function could be obtained by this method and would probably be necessary and advisable in all suitable cases and when the abduction treatment had failed to give a good union. It is surprising at operation to find many of these fractures of the neck of the femur are comminuted fractures, though X-ray fails to show but two main fragments. Until Doctor Beer had seen impacted fractures of the neck of the femur that had been broken up and treated by the abduction method in whom good functional results had been achieved, as far as breaking up impactions was concerned, he would still prefer to leave these patients impacted. At some future date he hoped Doctor Whitman would oblige the Society by showing some of his end results.

GOODWIN'S ARTHROMETER

DR H. H. M. LYLE demonstrated Goodwin's arthrometer for the simultaneous measurement of the metacarpal and phalangeal joints. Figure 1, shows the instrument. Figure 2, shows the method of using the arthrometer.

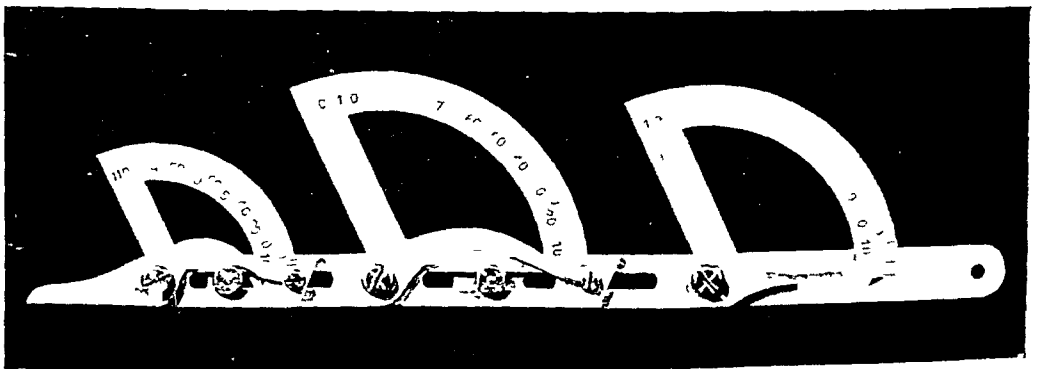


FIG. 1.—Goodwin's arthrometer.

A convenient way to employ this instrument in the measurement of stiff joints is to first measure the joints of the corresponding normal finger and express their relation to the contracted finger in fractional form. For exam-

THE OUTCOME OF INFECTIONS OF THE BILIARY TRACT

ple, if the normal terminal phalangeal joint has a flexion of 50° , the inter-phalangeal joint of 80° and the metacarpo-phalangeal joint 30° and the corresponding pathological finger joints a flexion of $10^\circ-40^\circ-15^\circ$, it would be written $\begin{smallmatrix} 10^\circ & 40^\circ & 15^\circ \\ 50^\circ & 80^\circ & 30^\circ \end{smallmatrix}$. In this way an accurate record of the improvement can be kept. The advantages of this arthrometer are self-evident, at one



FIG. 2 — Method of using arthrometer

glance the measurement of each individual joint can be obtained, or if desired, an accurate tracing can be made. It has a marked field of usefulness in detecting malingerers as it is extremely difficult for a patient to flex all the joints of the supposedly affected finger to exactly the same angle. Accurately recorded measurement by this instrument will soon uncover any shamming.

THE OUTCOME OF INFECTIONS OF THE BILIARY TRACT

DR. WALTER MARTIN read a paper with the above title, for which see page 424.

DR. ALLEN O. WHIPPLE said that Doctor Martin had summarized in one sentence, the principles that should be the guide in the removal of the gall-bladder. Reasons for removing the gall-bladder are when stones are present or when there is a well-recognized lesion, and the reason for not removing the gall-bladder is when no recognizable lesion is present. The point which it seemed to him had not been sufficiently emphasized in the discussion of the association between chronic cholecystitis and chronic appendicitis, was the difficulty of determining real lesions in gall-bladders without gall-stones, and in deciding what was a chronically inflamed appendix. To say that the large

proportion of appendices show lesions or are found to be associated with lesions of the biliary tract is based largely upon the individual's estimate of what chronic appendicitis is. There certainly is no real agreement as to just what is chronic appendicitis. This, in the speaker's opinion, was the weak point in Graham's work in connection with the liver, inasmuch as Graham has given too little consideration to what constitutes real pathology in the appendix in its rôle as a channel or portal of entry of infection.

DR FRANK S. MATHEWS said that in spite of some recent papers which have brought the question before the medical public, he considered that the question of the advisability of the removal of the gall-bladder in stone cases, had been settled in favor of cholecystectomy. The only objection to the more radical operation is from the occasional damage that may be done to the common duct, very rarely in the hands of capable surgeons, but not infrequently in the hands of inexperienced. He thought there might still be room for difference of opinion as to the advisability of removal of gall-bladders which depart but slightly from the normal. It seems difficult to believe that the gall-bladder showing the slightest evidence of inflammation can be the cause of pronounced symptoms, when we so frequently find gall-bladders showing most marked evidence of chronic inflammation in which both local and remote symptoms are conspicuously absent. He has never been impressed by the diagnosis of "chronic appendicitis" either as a pathological or clinical entity, and would consider that at the present time there is not sufficient evidence to show that chronic disease of the appendix is responsible for gall-bladder disease. In acute appendicitis, gall-bladder liver infections seem quite conspicuously infrequent, even as compared to such local infections as perinephritic and subphrenic abscess. He believed that at the present time the tendency of the medical profession is to attach undue importance to the appendix, cicatrized tonsils, and slight peridental inflammations. The tendency seems to attribute remote symptoms of the nervous and vascular systems to these structures in the absence of any definite local inflammatory symptoms and signs.

DR CHARLES GORDON HEYD thought that it was necessary in describing conditions in the gall-bladder to differentiate between surgical and pathologic nomenclature. A surgeon might believe a gall-bladder pathologic and meriting removal and yet the pathologist describes it in terms quite different. Furthermore, that he had referred to hepatitis, but did not wish it to be understood that the type of hepatitis that was associated with chronic inflammatory disease of the abdomen was a clinical entity, or had a clinical symptomatology. Yet hepatitis did exist and it did not invalidate the finding by the inability to trace the course of the infection from its source to its final injury in the liver no more than one could trace the course of a nephritis from its beginning up to urinary suppression. In regard to the clinical signs of appendicitis it would be necessary to differentiate the two types of appendices, the infantile type with a widely dilated valve of Gerlach would allow

THE OUTCOME OF INFECTIONS OF THE BILIARY TRACT

intracæcal drainage quite readily and yet not give clinical symptoms, but would probably show pathologic changes in the form of round-cell infiltration. It had been the experience of Doctor Heyd that the effect upon the gall-bladder of drainage was, as a rule, to increase the fibrotic elements in it and there was a distinct danger to the individual in leaving a chronically infected gall-bladder *in situ*, even if it had presumably been adequately drained. When Eisendrath reported 61 cases of injury to the common duct during the course of cholecystectomy and these injuries in the hands of very capable men it certainly was an argument for leaving the gall-bladder in place if it represented only minor degrees of pathologic change. Yet a gall-bladder that needed drainage many times required a second operation at some future time and this second operation certainly carried with it more danger of injury to the common duct at that time than did a primary cholecystectomy. Doctor Heyd thought that where the wall of the gall-bladder showed mural changes that was a gall-bladder that should be removed.

DR EDWIN BEER said that it was generally conceded that in the general circulation bacteriæmia occurred with some frequency, and such bacteriæmias, also well recognized, might be very transient as in the syndrome of furunculosis and cortical kidney abscess. Probably in the portal circulation very similar invasions took place. Autopsy material did show in some work done years ago, numerous instances of milary tuberculosis of the liver in the absence of general milary tuberculosis. In view of the fact that large tubercle lesions are rarely seen in the liver, it is presumable that the liver takes care of many of these tuberculous infections which probably originate in a tuberculous enterocolitis. In the production of cirrhosis of the liver it is, although as yet not proven, highly probable that bacteria may through the portal system reach the liver and there produce focal necrosis (followed by cirrhosis) having wandered through the diseased or chronically inflamed mucous membrane of the gastro-intestinal tract. It is highly probable that portal bacteriæmias are fairly frequent and possibly of no great significance. As yet, however, no definite method of clinical investigation of this problem has been elaborated.

A second point was in connection with the study of gall-stone formation. There seemed to be a very beautiful analogy between the formation of pure cholesterol stones in the uninflamed bladder and the formation of uric acid stones, or uratic stones, in the urinary bladder. Both form in non-inflamed organs, and probably only in cases in which stagnation of bile or urine is present. Probably due to some physical or chemical change in the colloidal solubility, stones of this type form in these two organs. The secondary stones, which form after infection has been super-added, are regularly of different composition, in the urinary bladder phosphates, and in the gall-bladder bilirubin calcium with or without cholesterol.

A third point was in connection with the presence of non-palpable symptomless stones in the common duct. There was no doubt that such stones

occur and can be the cause of symptoms after cholecystectomies without drainage and exploration of the common duct. He has repeatedly removed such stones and when doing such common duct explorations as a routine, he was surprised at the goodly percentage of such stones removed. About ten years ago he had shown a series of such cases to Dr. W. J. Mayo, who had expressed some surprise. A little later, a similar series was seen by another surgeon, who, apparently following this lead, had subsequently published along these lines. Doctor Beer himself had not as yet brought together his cases. Further study had, however, suggested to him that some of these cases had stones in the common duct which probably were pushed in through the cystic duct during gall-bladder manipulations. Since adopting the technic of constricting the cystic duct with catgut loops prior to cholecystectomy, a certain proportion of these quiescent common duct stones had been eliminated.

The fourth point worth mentioning was the possibility that some patients who have had common duct stones, may have recurrent symptoms as the result of the intra-hepatic stone formation. Such stones if small, and usually of bilirubin calcium, are liable to form behind a common duct obstruction, if a mild degree of cholangitis develops, and, as he has seen repeatedly, such stones wander down from the branches of the hepatic ducts producing colics, with or without transient jaundice, as they wander from the liver into the intestine. Only recently a patient with this pathology came to examination and a large number of such intra-hepatic stones were found in the dilated radicles of one of the hepatic ducts.

DOCTOR MARTIN, in closing the discussion, said he believed all grossly infected gall-bladders and all gall-bladders containing stones should be removed unless there was an obvious contra-indication. The difficult question, to his mind, was the determination of the lesion of the gall-bladder wall. He thought it a good rule to confine oneself to removing only gall-bladders that gave outward and visible signs of infection.

In regard to the points raised by Doctor Beer as to the frequency of portal infection, he would refer to the work of Adams and his co-workers. They found very frequently low-grade infection of the liver from portal sub-infection. In regard to stones being pushed through the cystic duct into the common duct when the gall-bladder was removed, he was sure that it often happened and that one should be cautious in making rough manipulations and squeezing the gall-bladder until the cystic duct was isolated and clamped.

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ANNALS of SURGERY

227-231 S. 6th Street

Philadelphia, Penna.

ANNALS *of* SURGERY

VOL LXXIX

APRIL, 1924

No 4

A PLAN OF MANAGEMENT OF CRANIAL INJURIES BASED ON A NEW GROUPING OF SUCH INJURIES

BY J STEWART RODMAN, M D

AND

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MUCH confusion has arisen concerning the term concussion, contusion, and compression of the brain. When, as is so often the case, these conditions are complicated by other conditions such as intracranial hemorrhage, there is still greater difficulty. It is frequently difficult, therefore, to draw a clear mental picture of the underlying pathology of these conditions and hence to decide which cases fall under these various clinical headings. It follows that without a "clear-cut" understanding of the pathology and, therefore, of these clinical conditions themselves, it is impossible to lay down adequate regulations for treatment. It was the idea of attempting to clarify this atmosphere in our own minds that led us to discard the terms of concussion, contusion and compression for practical use. The grouping of brain injuries which we suggest in their place has at least the advantage of simplicity, a much needed factor in any attempt to substitute one classification for another in regard to these injuries. In fact, classifications of disease or traumatic conditions in general have no value, unless on the basis of such a classification a rational treatment can be built. This essential we believe is met in the grouping we propose.

In dealing with intracranial lesions, acute or chronic, caused by disease or trauma, a most important factor to take into consideration is *intracranial pressure or tension*. In most of the chronic lesions, as brain tumors, intracranial tension is given the importance due, but such is not the case in acute brain injuries. It is our belief that acute intracranial tension is just as important as chronic intracranial tension. Much has been written of acute brain injury and we do not propose to quote from this extensive literature. But while acute intracranial tension is often referred to, notably by Jackson and Sharpe, it seems that to few is it the one condition which means life or death to the patient. It has come to be our belief that this is so irrespective of whether we label these cases concussion, contusion or compression. Fortunately, intracranial tension can be estimated by clinical as well as by a more exact means, namely, the spinal manometer. Furthermore, each of these groups have definite indications for treatment based entirely on the presence

or absence of increased intracranial tension On this basis we now classify all cases of brain injury as follows

Group 1 No increase in intracranial tension

Group 2 Moderate increase in intracranial tension

Group 3 Marked increase in intracranial tension

In order to determine which of these groups the patient falls into, the following observations can now be made, after the stage of surgical shock has been passed

A General examination including neurological findings

B Observation of the temperature, pulse, respiration and blood-pressure every four hours

C X-ray of skull

D Spinal puncture, being careful to estimate pressure by means of the spinal manometer As a result of examination the following types of cases will readily fall into one of these groups Some will, of course, pass in progressive stages from one group to another

Into Group 1 (no increase in intracranial tension) those cases will fall showing a normal spinal pressure of 8 to 10 mm of Hg and a normal or slightly elevated blood-pressure To these essential findings may be added the less important ones of a normal or slightly elevated temperature, pulse and respiration, primary unconsciousness, either momentary, or at most, lasting for several minutes, followed by headache and dizziness Normal eye grounds The treatment of this group is, of course, non-operative and consists of

A Rest in bed (four to five days)

B Ice-cap to head

C Sedatives as needed

These cases of Group 1 always recover unless some serious complication arises

Into Group 2 (moderate increase in intracranial tension) those cases will fall showing a spinal pressure from 10 to 18 mm of Hg moderate rise in blood-pressure, moderate rise of temperature and pulse-rate, and a normal respiratory rate These cases may show the primary unconsciousness, followed by dazing and headache mentioned above To these mental symptoms may be added mild confusion or delirium after the period of unconsciousness has passed The eye-grounds will show a congestion of the retinal veins The indications for treatment in this group are again non-operative and will consist of

A Rest in bed

B Ice-cap to head

C Elevation of head of bed

D Therapeutic spinal puncture (10 to 25 cc of spinal fluid may be removed as often as necessary usually every twenty-four hours for several days or as much as is needed to reduce the reading of the spinal manometer to 8 to 10 mm of Hg)

MANAGEMENT OF CRANIAL INJURIES

E Intravenous injection of hypertonic saline (60 to 80 c c of a 15 per cent solution) or magnesium sulphate by rectum as advocated by Fay¹ Because of the ease with which magnesium sulphate may be given, this is perhaps more practical than the intravenous injections of hypertonic saline, although the latter solution is quicker in its effect and in the majority of the cases of this group it is only necessary to give one injection

The majority of the cases of this group will get well unless some serious complication arises

We believe that approximately 70 per cent of all cases with brain injury will fall into one or the other of these two groups

Into Group 3 (marked increase in intracranial tension) will fall those cases showing a spinal pressure above 18 mm of Hg an increased blood-pressure which will fall as this stage progresses (Pulse-pressure is much more valuable than systolic or diastolic readings, when the pulse-pressure equals the pulse-rate, a good, single indication for operative relief of tension exists) These cases will show a normal or slightly elevated temperature until the final stage (medullary oedema) when hyperpyrexia is present The pulse-rate will gradually become slower as well as full and bounding until it becomes subnormal as pressure advances In the closing stage the pulse will again become rapid and weak There will be stupor increasing to coma The eye-grounds will show congestion of the retinal veins, and uncommonly, paling of the optic disk (We believe that true choked disk does not occur in an acutely increased intracranial tension but optic atrophy may develop later)

This group we believe calls for operative relief of tension, in addition to the measures outlined in the preceding two groups It is our practice to perform a subtemporal decompression on the right side with drainage and at times a bilateral subtemporal decompression

Since making use of this plan of management of cranial injuries, twenty cases have come under our observation This small number is much too few from which to draw accurate deductions, and yet we feel justified in making a preliminary report of this plan at the present time because of the tremendous help we have derived from it in treating these cases and particularly in making the difficult decision for or against operative relief of tension That acute intracranial tension cannot be relieved to any appreciable extent by means of a subtemporal decompression we have often heard We feel sure that such tension can be relieved if the operation be done sufficiently early and yet, after conservative methods have had a reasonable trial There has been ample clinical proof of this fact in the work as it has progressed thus far

By following this plan, it has been comforting to know by accurate findings that increased intracranial tension has been maintained, in spite of conservative methods to reduce such tension and that, therefore, operative relief must be resorted to There are many problems, of course, that have arisen during the observation of these first twenty cases on this plan We hope to report on some of these problems in later reports on this subject, at which time we

expect to report statistics involving a series of cases so grouped and treated, sufficiently large to warrant drawing conclusions. The value of this plan lies chiefly in determining and treating accordingly those cases of intracranial injury falling into Groups Nos. 2 and 3. We do not, of course, perform lumbar puncture on the obviously mild case as the general symptoms will make it unnecessary to do so. Fortunately, as we have already stated, increased intracranial tension has other symptoms as the pulse-rate, pulse-pressure, mental condition, etc., none of which are complete, however, until to them a spinal pressure reading is added.

We have purposely omitted from this discussion such frequent complications of brain injuries as scalp wounds, fractures of the skull, intracranial hemorrhage, penetration of foreign bodies and localizing pressure on the brain from any cause, believing that these complications are operative indications in themselves and that the operative management of these complications has now been well standardized in general.

REFERENCES

- ¹ H. Jackson. *Surgery, Gynecology and Obstetrics*, April, 1922, No. 4, vol. xxxiv.
- ² William Sharpe. *Canad. M. A. J.* Montreal, vol. xii, p. 761, November, 1922.
- ³ Weed and McKibben. *Am. Jour. of Physiology*, vol. xlviii, 1919, p. 554.
- ⁴ Temple Fay. *J. A. M. A.*, vol. lxxx, p. 1445, May 19, 1923.

ARTHROPLASTY UPON THE TEMPOROMANDIBULAR JOINT*

By GEO M DORRANCE, M D , DOUGLAS WEBSTER, D D S

AND

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It is stated that a proportion of cases of ankylosis recur after operation Why? We have classified the causes of these recurrences in three groups

1 Operations performed upon cases that are still in the active stage of arthritis 2 Incomplete operations 3 Cases where either inadequate or no forms of excisors were used

These groups cover the entire field and are self-explanatory The main cause of recurrence seems to be the lack of appreciation of the pathological changes produced in the muscles and fascia outside of the joints

The pathological cause of ankylosis of course varies in the different cases It has been well described elsewhere and has very little bearing on the prevention of recurrence It will be admitted in this discussion that no cases should be operated upon until months after all active arthritis have subsided In all cases that have had bony ankylosis for any length of time (my cases varied from six to twelve years) a muscular atrophy is produced from disuse with an invasion of fibrous tissue in the muscle, the fascia layers are shortened or have not stretched as they would have in the growth of the normal individual From the muscular atrophy, the contractility of the muscle is impaired so that normal opening and closing could not be obtained if the joints were normal To explain it more fully, we would compare it to a fractured arm which had been kept in the cast for ten weeks One notes in the arm, it is impossible to move the fingers when the cast is removed, and it takes several weeks or months of training to redevelop the muscles of the arm, and if this is true of the arm, it is equally true of the muscles of the jaw, only in ankylosis of the jaw, it is frequently locked for years

In cases just operated upon, we find the recovery of motion and the freedom of action is greatly increased by the use of some form of exercisor to redevelop the muscles and stretch the fibrous tissues

In the first group of cause of recurrence, that is patients operated upon where there is still progressive arthritis present, an exercisor is the only means of retaining motion We have increased the motion in the one case that came under our notice ten weeks after operation In group 2 where incomplete operations have been performed, if an exercisor is used, the distance gained and freedom of motion is increased As used on our newly operated cases, no difficulty was encountered

* Read before the Philadelphia Academy of Surgery, December 3, 1923

The study of selecting the best variety of exercisor has led us to use dental appliances, but they were discarded as impractical. Even the best required constant attention and are only applicable for each case. An exercisor which was applicable to all cases was finally developed. It has given entire satisfaction. The exercisor is composed of two flat plates, which are connected on either side by a spring which extends out approximately six inches. These springs are in turn connected one to another by a rod to prevent play. To strengthen these springs, two extra springs are placed on either side.

The method of use of this exercisor is to place the plates in apposition, then introduce the plates between the upper and lower jaw with the springs controlled by the hands of the patient on either side and gradually relaxing the grasp of the hand. The jaw will then be forced open. Now, have the patient attempt to close the jaws, thereby exercising the muscles of mastication and when he releases these muscles after an attempt to close, there is a sudden give which adds a little to the opening each time it is used. The mechanical action each time causes the atrophied muscles to redevelop. These exercisors should be used every two hours, the amount of force being first controlled by the hands on the springs. It is interesting to see the muscles redevelop and the patient enabled to open the mouth wider and wider. This is not all the exercisor does. It apparently causes the jaw to develop and take on the adult contour, for in cases where the jaw is locked in childhood, if seen in youth, there is a separation of the front teeth of one to one and a half centimetres. With its use, we have seen cases with contraction and limited motion develop so that a second operation was not necessary, as they had sufficient motion for chewing and speaking. We feel with this exercisor we can now practically state that no recurrence will occur with a correctly selected and performed arthroplasty. This exercisor is the result of the best and simplest of a considerable number of appliances which we have had made. It has the following advantages. It is of simple construction and can be controlled by the patient. It can be used interruptedly. The strength of the spring can be graded. So as to make it unnecessary for others to repeat our experiments, we would state we have tried clothes pins, wooden wedges, etc., and have discarded them as poor makeshifts. Permanently applied appliances to the teeth have to be applied by a dentist. They are difficult to obtain and inconvenient to the patient. They cannot be removed and are unsanitary as a rule. We have used a great many of the different varieties, but are entirely satisfied with the present model of exercisor. It has been well tested out. It may be added that in fibrinous contraction of various varieties, it has been of value to us. We would warn that no exercisor of any type should be used on any teeth in front of the canine, as frequently the teeth protrude forward and special pressure does not press upon the tips but only on the inner surface, thereby loosening the teeth and only too frequently a pericementitis develops and finally death of the teeth results.

The variety of the incision may be straight up and down in front of

the ear One with the added triangular incision at right angles, to this over the zygoma or the question mark incision of Blair may be used The next point injury to the facial nerve If it is a bony ankylosis, we agree that the nerve supply to the occipital frontalis is frequently impaired and this is caused not so much by cutting as by stretching the nerve to obtain sufficient room to remove the necessary amount of bone Next amount of bone to be removed It is much better to remove too much of the condyle than not to remove sufficient, and we have seen cases in which too little bone has been removed We had one case in which we found it necessary to divide the coronoid process before dilatation could take place The next point in technic which we want to clear up is the question of whether the introduction of fat, either free or pedicled or muscle, is necessary We are agreed that none of them are essential to obtain a good joint They do no harm and may be used, but with the use of the exercisor after the removal of the bone, recurrence does not take place We do feel there is less danger of infection, if the fat and muscle are not employed It is noted in the literature that it is difficult to determine which side is ankylosed, and in several cases the well side is operated upon In a well-studied case, this should not occur The history will usually assist one If the condition is unilateral, there is usually some spring on the normal side and a flattening of the diseased side of the face Careful X-ray pictures, which may have to be repeated several times, will usually clear up the matter

Conclusions In all cases, it is essential to use an exercisor as a post-operative measure It is advisable to remove most of the condyle Any pressure made upon the teeth should be upon the canine or those posterior to the canine

It is non-essential to interpose any material between the divided bones

Injury to the occipital frontalis branch of the facial nerve frequently occurs No touch technic should be employed

MALIGNANT TUMORS OF THE THYROID*

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Of 290 patients with malignant tumors of the thyroid seen at the Mayo Clinic between January 1, 1901, and January 1, 1921, there were nineteen with sarcoma, sixty-two with carcinoma, 102 with malignant adenoma, and with carcinoma not operated on because the condition was considered inoperable on account of extensive growth or metastasis

Of the nineteen patients with sarcoma of the thyroid, eighteen are known to have died from the malignant condition. One patient could not be reached by repeated letters and has probably died from the malignant condition. Sixteen died from the condition in from two to twelve months after operation. The average duration of the post-operative course in these sixteen patients was about six months. Two lived five and six years, respectively, after operation. The prolongation of life, or perhaps better, the duration of life post-operatively, averaged less than a year. The mortality, then, is practically 100 per cent. It seems that sarcoma of the thyroid progresses to a fatal end, about as rapidly as any malignant condition known.

Of the sixty-two patients operated on for carcinoma, twenty-two are alive with no recurrence. These are mostly patients operated on less than five years ago. Only three of these twenty-two patients have been cured for more than five years. Expressed in percentage, there are 5 per cent with five-year cures, and 30.6 per cent with cures of shorter duration. Of course, some of the patients listed as cured for one year may possibly live five years or more. Ten (16 per cent) of these patients have developed recurrences and will probably die soon from the malignant process, which in this type of malignancy develops very rapidly. Thirty (48.4 per cent) are already reported dead by replies to circular questionnaires. Twenty-six of the thirty (42 per cent) died during the first pre-operative year. This fact emphasizes the previous statement that the patients who have carcinoma of the thyroid and have been operated on, die very soon if recurrence occurs.

The results of operations on patients with malignant adenoma are not so discouraging as the results of operations on patients with carcinoma. Thirty-nine of the 102 patients with malignant adenoma (about 38 per cent) are alive without recurrence. Eighteen (17.6 per cent) of the thirty-nine are alive more than five years after operation. These figures are in marked contrast to those concerning patients operated on for carcinoma, since only

*Abridgment of thesis submitted to the Faculty of the Graduate School of the University of Minnesota, in partial fulfillment of the requirements for the degree of Master of Science in Surgery, October 1923.

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three (5 per cent) of such patients were alive more than five years after operation. Fifty-three (about 52 per cent) have reported recurrences. Many of them, however, did not have early recurrences, as thirteen occurred in the third year, fifteen in the fourth year, and only six during the first year after operation. Ten (10 per cent) of these patients have died from malignancy after operation. Of these ten, five lived five years or more, and only two died less than a year post-operatively. It is evident that operation prolongs life much more if patients have malignant adenoma than if they have carcinoma. Likewise the number of five-year cures is greater in cases of malignant adenoma than in those of carcinoma.

Of the twenty-four patients with malignant papilloma, sixteen (66.6 per cent) operated on report that they are well, with no recurrence after operation. Eight of these are in the group cured for five or more years. Six (25 per cent) of these have died from recurrence. Four died during the first year after operation, one during the third year, and one during the fourth. Only two have reported recurrences, one two years, the other more than five years after operation. There are nearly twice as many recurrences in cases of malignant adenoma as in those of malignant papilloma, if we count the patients who died from recurrence as well as those who are living with recurrence. There are 62 per cent of recurrences in the group of patients with malignant adenoma, and but 33.3 per cent in the group of patients with malignant papilloma. However, we are dealing with very small groups of patients. It would appear that the malignant papilloma is the least malignant of thyroid malignancies.

All of the cases, exclusive of the cases of sarcoma, were studied with special reference to encapsulation of the growths. One group contained all the cases in which the growth had not invaded or broken through the thyroid capsule, the other all those in which the tumors had broken through the capsule and were invading the surrounding tissues. Sixty-two (47 per cent) of the patients with encapsulated tumors were reported free from recurrence at the various post-operative periods. Fifteen (26 per cent) with non-encapsulated or infiltrating tumors were reported free from recurrence at the various post-operative periods.

From these figures it seems that encapsulation is as important in malignancy of the thyroid, as in malignancy of any other part of the body. It would seem that encapsulation increases the prognosis almost 100 per cent, because the results in the cases of encapsulated tumors are almost twice as good as in those of non-encapsulated tumors. The results even in the infiltrating cases are worth while, and would argue for surgery even when exploration reveals the growth to be of this type, provided, of course, removal is technically possible.

The foregoing tabulations have a practical value in enabling the surgeon to know by pathologic diagnosis at the time of operation with what degree of malignancy of the thyroid he is dealing. The surgeon will also have some idea of the prognosis. It would seem from this study that all tumors of the

thyroid, except sarcomas, capable of surgical removal, should be considered operable and a thorough operation performed

The extent of operation varies according to the condition. In cases in which malignancy has been found encapsulated in a single adenoma, the adenoma is enucleated. This operation is considered as radical as extirpation of the whole gland. A few malignant cells in an adenoma of the thyroid are considered quite differently from a few similar cells in the breast, in which a single group of malignant cells would require at least wide excision of tissue surrounding the malignancy, if not radical amputation with axillary dissection and removal of the pectoral muscle. In cases in which there are several adenomas, with or without malignancy, all of the adenomatous thyroid tissue should be removed.

If the growth is diffuse, total extirpation of the gland should be performed in some cases, according to the surgeon's judgment and its technical possibilities. When growth is extensive, infiltrating surrounding structures and causing respiratory embarrassment, palliative operations have been performed to relieve dyspnoea, with surprising results in several instances. These results are interesting. Total extirpation, of course, does not remove the parathyroids, which are left with a small bit of capsule. Formerly by thyroid feeding, and now by accurate means of thyroxin feeding controlled by basal metabolic studies, a patient does not suffer from loss of the secreting tissue. In all ten cases extirpation was performed for extensive involvement of the gland. Seven of the cases were carcinomas and three malignant adenomas. Five of the carcinomas were encapsulated. Two of the five patients are in excellent health without a recurrence two and five years, respectively, after operation, one died from recurrence seven years after operation, one died three months after operation and use of radium and X-rays, and one died two months after operation and X-ray treatment. One of the two cases of carcinoma in which the capsule had broken through, was really inoperable as the growth could not be cleanly removed, and the patient died one month after operation. The other patient lived a year after operation and died of recurrence. In the three cases of malignant adenoma, two of the adenomas were encapsulated and one had infiltrated the capsule. One of the patients with encapsulated malignant adenoma had been operated on elsewhere and has not had a recurrence one year after operation. The other is well and has not had a recurrence five years after operation. The patient with malignant adenoma which had infiltrated the capsule is well one year after operation and radium therapy. Although the cases are few, the good results would seem to argue for radical procedure when indicated.

The results in the next three cases are mentioned only as a matter of interest and not as an argument for extensive surgery in inoperable cases. From one patient a malignant papilloma involving the trachea and oesophagus was removed with a strip of trachea and oesophagus. This patient is well with no recurrence nine years after operation. Another patient, who had a malignant papilloma, about 17 cm in diameter, which had perforated the skin,

is well with no recurrence four years after radical removal of all the involved tissue, including an elliptical portion of skin. In the third case a malignant papilloma involving the right lobe was extirpated, and, while still at the Clinic, several glands below the angle of the jaw were found to be enlarged, and were removed. These glands had metastatic growths. There have been no signs of recurrence two years after operation. These cases would seem to indicate that apparently inoperable cases are often operable, but they are too few to offer a strong argument. It does indicate, as do also the previous data, that malignant papillomas are the least malignant of the thyroid malignancies.

Radium has been used in a few cases, but not long enough so that accurate deductions as to its value can be drawn. Radium or X-ray or both are now routinely used in conjunction with surgery in all operable malignant cases, and in certain inoperable malignant cases.

Diagnosis As has been stated by Wilson, 70 per cent of the cases of malignancy of the thyroid were missed clinically in this group of cases. On the other hand, in defence of the clinician, it must be said that most of these growths were encapsulated and many impossible to diagnose, clinically, as positively malignant. Since the pathologic diagnosis at the time of operation is sometimes incorrect, the subsequent course in the patient is the deciding factor.

The diagnosis, of course, is easy if the patients have hard, fixed, infiltrating growths with demonstrable metastasis in glands or lungs or elsewhere, hoarseness from involvement of the recurrent laryngeal nerve, dysphagia or pain, or if the patients are of the cancer age and have a steadily and rapidly growing enlargement of the thyroid. It is, however, impossible to make a positive diagnosis of malignancy in the large group of well-encapsulated borderline cases. The factors which should make one suspicious of malignancy are (1) either a steadily and rapidly growing tumor of the thyroid or a tumor growing slowly and steadily over a period of years in persons of cancer age, between forty and fifty years, (2) the hardness of adenomas of the thyroid with a normal basal metabolic rate in the fifth decade, and (3) the signs of extension of growth mentioned.

A word here is not out of place concerning the slowly growing tumors of long standing which in the first group of cases comprise 30 per cent, in contrast to 25 per cent of the very rapidly growing tumors. This has not been brought out before except by Wilson in his work on the same group of cases.

Differential Diagnosis The following condition we should try to differentiate from malignancy (but if we err it should be on the side of malignancy, and the pathologist should decide at operation) (1) benign adenomas of the thyroid with different forms of degeneration, (2) adenomas with hyperthyroidism, (3) exophthalmic goitre, (4) inflammatory conditions of the gland, (5) tuberculosis of the gland, (6) branchial cyst, and (7) malignancy of aberrant thyroid tissue. All are conditions in which certain facts can be of assistance in attempting to differentiate.

Because of the occasional microscopic demonstration of early malignancy in cases of clinically benign adenoma, malignancy should be considered when a patient of cancer age with adenoma presents himself. One can only say that such a condition is probably not malignant because it has not grown, it is not hard, and because there are no signs of metastasis. A negative X-ray of the chest would not indicate malignancy. A routine X-ray examination is made here of the lungs and chests of all patients with goitre, and the patients in a number of cases which would otherwise have been considered operable have been spared the suffering and expense of a futile operation. Adenomas with calcareous degeneration often suggest malignancy, but, as a general rule, their typical stony hardness will help to distinguish them from malignancy.

Adenomas with hyperthyroidism usually are not malignant. In this series of cases it is impossible to tell how many of the patients had hyperthyroidism, because their basal metabolic rates were not determined. Only a rough estimate is possible, judging each case by its clinical record which includes the history and physical examination. By this method about 3 per cent of the cases with malignant thyroid disease had definite evidence of hyperthyroidism. Boothby, in a study of basal metabolic rates made in forty-five cases of known malignancy, found definite hyperthyroidism in 22 per cent. Practically, this is of little consequence as malignancy would be found at operation, which is the proper treatment for adenomas with hyperthyroidism.

Exophthalmic goitre is mentioned only because some cases of malignancy in exophthalmic goitre have been reported in the literature. No case has been found here in 5867 cases of exophthalmic goitre. The gland itself in exophthalmic goitre is often quite hard, and, if the other characteristic features of the disease were absent, would readily be suspected of being malignant.

An inflammatory condition of the gland may infiltrate the capsule and feel like a malignant condition, but the history and physical examination will help to differentiate such conditions. With inflammation there will be a history of fever, local heat and possibly redness and swelling, with or without regression, depending on the stage of the condition. If acute, local redness and heat will differentiate it. Malignancy and inflammation may coexist. Necrotic and purulent material was discharged by one patient here who died very soon with inoperable carcinoma. Thyroiditis is likely to be diffuse, especially in the early stages, whereas malignancy is more likely to be localized in one portion of the thyroid.

Certain cases of tuberculosis of the thyroid may be diagnosed as malignant. The cases of tuberculosis in the later stages when the gland is not hyperfunctioning are the ones to be differentiated, and this can usually be done if there is a history of a previous exophthalmic phase. Of seven cases of tuberculosis of the thyroid reported by Plummer and Broders, three were considered malignant with no hyperthyroidism, or with only a slight degree of hyperthyroidism.

Branchial cysts may be confused but the location should rule out thyroid disease as these cysts occur outside of the normal location of the thyroid

Malignancies of aberrant thyroids are differentiated by their location and are very rare

Metastasis Metastasis to bone is most likely to occur from thyroid and prostatic tumors. Muller and Speese, in a group of 257 cases, 238 of which were reported by Ehrhardt, found metastasis to the bone in seventy-three cases. Limocher asserts that bone is more commonly involved than the lungs, and Crotti that metastasis to bone is most likely to be found in cases of malignant adenoma. The metastasis in the cases at the Mayo Clinic does not correspond with these observations. Only two cases with metastasis in bones were found, and these occurred in cases of carcinoma. In nearly all the inoperable cases, the regional lymph-glands were involved, and in many there were growths involving the trachea, œsophagus, vocal cords, and other adjacent structures. In eighteen cases there was metastasis also in the lungs, in five in the liver, in four in the abdomen, in two in mediastinal glands, in two in the brain, in one in the kidney, and in one in the chest wall. Thus the lungs and liver in order were the most frequent sites of metastasis in these cases. The course of the malignancy in the cases considered inoperable at the time the patients were examined in the Clinic has been very rapidly fatal in nearly all. Forty of the eighty-three patients died within three months, twelve within one year, and nine within two years after examination, seventeen letters of inquiry were returned unclaimed, most probably because of death, two patients died of diseases other than malignancy, after examination, one is alive six months after examination and is being treated by radium, one is alive one year after examination, with a slowly growing tumor, and one is alive one and one-half years after examination and being treated by radium and X-ray.

CONCLUSIONS

- 1 The degree of malignancy in the lesions of the thyroid is according to the order in which they are mentioned: sarcoma, carcinoma, malignant adenoma, and malignant papilloma, sarcoma being the most malignant and papilloma the least.

- 2 By far the best results are obtained in the cases in which operation is performed before the malignancy has infiltrated the capsule, and this group of cases is the one in which the clinical diagnosis of malignancy is rarely made.

- 3 Occasional unexpected happy results occur in cases of malignant papilloma found practically inoperable at the time of operation, but in which radical removal of infiltrating growths, and even of glands infected by metastasis, has been practiced.

- 4 There is no grave contra-indication to total extirpation, so far as myxœdema is concerned, in cases in which all tissue infected by malignancy may be removed.

5 X-ray and radium therapy have not been used long enough nor on a sufficiently large number of patients to estimate their true worth

6 Metastasis to bone is rare in this group of malignancies of the thyroid. The lungs and liver in the order named are the most common sites of distant metastasis.

7 The possibility of malignancy is too rarely thought of in adenomatous tumors of the thyroid in patients of the fifth decade, and this possibility is not used often enough as an argument to urge operative treatment for these patients.

8 A careful follow-up system should be used in all cases of questionable malignancy, and persisted in for at least ten years before the case is considered benign.

EXOPHTHALMIC GOITRE RESULTING IN BLINDNESS FROM CORNEAL ULCERS

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IN reviewing the literature of the last twenty-five years on goitre, I find there are very few references made by either surgeons or internists to corneal ulcers resulting in blindness, as a sequela of exophthalmos in cases of exophthalmic goitre. Most of the references are by the ophthalmologists. Few of the standard books on goitre make any mention of it. Bram refers to it in his book on "Exophthalmic Goitre and Its Non-surgical Treatment."

Corneal ulcers may develop very early in cases of exophthalmic goitre and are not necessarily confined to the long-standing ones. Knapp¹ reports a case of loss of sight in left eye and partial vision in right within five months from onset of enlargement of eyes. Wood² reports that dryness of the eyes is one of the commonest complaints made by patients with exophthalmic goitre. In severe cases of exophthalmic goitre one should bear corneal ulceration constantly in mind, as it may appear at any time and has no relation to the duration of the disease.

Treatment Local therapy seems to have very little effect on the eye condition and the cases usually progress to complete or partial loss of vision. Sattler³ says "Local therapy avails but little." In 1907, he collected and reported forty cases where both eyes were lost, nine, complete in one eye and partial in the other, and fourteen, with complete opacity of one cornea. Irrigations, argyrol instillations, bandaging, tarsorrhaphy, and resection of the outer wall of the orbit have been tried with very little success.

General treatment has consisted in ligation of all the thyroid arteries, cervical sympathectomy, X-ray, and administration of thyroid extract. Rogers ligated the left inferior artery in Knapp's case, with very little result, and later ligated the remaining arteries. The patient lost sight in his left eye but had partial vision in the right 6-200. Cervical sympathectomy has been tried a number of times with practically no improvement of the eye conditions. Bram⁴ quotes a case in which the administration of thyroid extract grs v, t i d by family physician, resulted in ocular dislocation with bilateral panophthalmitis and, later, enucleation. Bram states that no general therapy lessens the exophthalmos promptly enough to safeguard the affected cornea.

I have seen no mention made of partial thyroidectomy in cases of corneal ulceration. It would seem to be the logical procedure, as all other forms, both local and general, apparently fail to arrest the progress. De Schweinitz⁵ states that partial thyroidectomy meets with great success in the relief of exophthalmos. The following case is reported to show what may be accomplished with surgery, even in neglected cases of exophthalmic goitre.

CASE—P G, male, age forty-eight, married, mechanic Seen April 10 1923
Chief complaint, goitre Family history unimportant for disease of the thyroid gland

Past History—Had usual diseases of childhood, no history of typhoid, pneumonia, scarlet fever, or rheumatism Had influenza eight years ago Patient contracted syphilis at the age of twenty and has been treated for it by different physicians since that time One physician has been treating him for the past eight years

Present Illness—Seven years ago patient became very nervous, noticed swelling in the neck, which was soon followed by enlargement of the eyes and palpitation of the heart He consulted a physician who kept him under treatment for two years with different medications, but was not improved and was referred to a surgeon for operation Admitted to hospital and remained five weeks, at which time he had his superior thyroid arteries ligated but his condition would not permit the removal of the goitre Three weeks after discharge, he consulted his surgeon, and was advised to return to work He was not instructed that a second operation was necessary for the removal of the goitre He then returned to the family physician, and was told that he could be cured with medical treatment He continued to work at his occupation as mechanic until December 20 1922

The following history was taken from the records of the Manhattan Eye Ear and Throat Hospital, Doctor Thomson's* service, where he was attended by Doctor Skeel †

"December 21, 1922 Chief Complaints —Eyes sore and painful, and failing vision

"Five days before admission, patient was doing some painting and noticed that his eyes began to smart His eyes remained red the next day but he returned to work in the machine shop The third day his vision became a little blurred—more so in the left eye He returned to work the fourth day and his eyes pained considerably that night He consulted his doctor who gave him some drops to use The doctor saw him the next morning and sent him to the Manhattan Eye, Ear and Throat Hospital On his arrival, his vision had failed decidedly, and he was suffering from considerable pain in his eyes

"Admission note Marked exophthalmos, O U, with subconjunctival circumcorneal injection very marked, large deep ulcers on lower half of each cornea with large slough present on each, remainder of cornea somewhat hazy O U Iris O U muddy and sluggish Considerable pain O U

"Vision O D, large objects, O S, large objects Diagnosis 1 Exophthalmic goitre 2 Perforating ulcers of cornea, O U, with iritis "

The treatment consisted of boric irrigations, castor oil instillations, cold compresses over eyes and bandaging of eyes for protection when compresses were not on This therapy was continued until January 19th, when patient had one grain of thyroid extract, t i d, for two weeks In spite of this treatment the ulcers were becoming progressively worse

On February 17th, under local anæsthesia, the right eye was enucleated The patient was discharged from the hospital on March 2, 1923 The discharge note gave Vision O S, place and shadows

Physical examination, when seen by me April 10, 1923, a very nervous and excitable man, poorly nourished, with loss of muscle tone and fifty pounds under normal weight Head and neck Right eye enucleated Left eye can see only shadows Neck Two scars over upper part of thyroid gland Patient has a goitre with symmetrical enlargement and definite thrill on palpation Chest Poorly nourished, no râles heard on auscultation Heart Apex in 5th interspace in mid-clavicular line, no murmurs heard,

*I am indebted to Dr E S Thomson for the privilege of using the records of the Manhattan Eye, Ear and Throat Hospital on this case

†In a personal communication from Doctor Skeel he says he "does not think the positive Wassermann had any direct bearing on the production of the corneal ulcers"

EXOPHTHALMIC GOITRE RESULTING IN BLINDNESS

marked arrhythmia Pulse, 124 Blood-pressure, 150-90 Abdomen Liver not palpable Extremities Fingers have a *fini tremor* Patellar reflexes Normal

Admission to hospital was advised and accepted, April 26, 1923 Laboratory findings—April 27, 1923 Urine Albumin, 2+, sugar, negative, acetone and diacetic acid, negative Microscopic, negative The blood count showed Erythrocytes, 4,400,000, and otherwise negative Chemical blood analysis Normal Basal metabolism, 64 per cent above the average normal

The patient's temperature varied from 99° to 103.5°, with pulse varying from 90 to 134 The average temperature was 101-2, and pulse 120

Treatment—Absolute rest in bed, with forced fluids and carbohydrate diet, tincture of digitalis, M, x, t i d, luminal, grs 15 q 4 h, pancreatic substance, grs 11, q 4 h, codeine, grs ss, o n

Two weeks later, the basal metabolism was 47 per cent above the average normal

Operation on May 16, 1923 Gas oxygen anaesthesia, partial resection of thyroid gland bilateral, leaving about one-seventh of gland substance *Convalescence* After the first twenty-four hours, the patient's temperature remained under 100.6°, and he was out of bed on the sixth day and discharged on the ninth

Follow-up Patient has gained steadily and progressively in strength and vitality since leaving the hospital When last seen, October 3, 1923, his weight was 148 pounds, as against 50 pounds, at the time of operation Pulse, 80 Temperature, 98.4 Basal metabolism, 3 per cent above average normal

Patient's statement at this time, "Feels normal in every way, and only complaint is lack of vision"

CONCLUSIONS

- (1) Corneal ulcers may develop at any stage in exophthalmic goitre
- (2) Local and general therapy have given very unsatisfactory results
- (3) Partial resection of the thyroid gland, seems to offer the best chance of arresting corneal ulceration in exophthalmos, resulting from exophthalmic goitre

REFERENCES

- ¹ The Surgical Treatment of Corneal Suppuration in Exophthalmic Goitre A Knapp, Arch Ophthal, vol xlvii, p 173, 1918
- ² The Ocular Signs and Symptoms of Exophthalmic Goitre C A Wood, Ill Med Jour, vol xi, p 263, March, 1907
- ³ Graefe Saemisch Handb der ges Augenh, Kop, vol xiv, p 126, 1908, Sattler
- ⁴ Exophthalmos in Exophthalmic Goitre A Study of 400 Cases I Bruns, Am J Ophth, vol v, p 609, Aug, 1922
- ⁵ Diseases of the Eye, G E De Schweinitz W B Saunders Co, Phila and London, 1921

BIBLIOGRAPHY

- A Case of Acute Exophthalmic Goitre with Ulcerative Keratitis J Griffith, Brit Med J, vol 11, p 490, 1898
- Goitre exophthalmique et complications oculaires de Lapersonne Rec d'opht, vol xxvi, p 158, 1904
- Ueber die Augensymptome, der Basedow's chen Krankheit Sattler, Deutsche med Wchnschr, vol xxx, p 527, 1904
- Ueber die Augensymptome, der Basedow's chen Krankheit Sattler, Deutsche med Poppen Deutsche med Wchnschr, vol xxxvi, p 2002, 1910

J WILLIAM HINTON

- Eye Diseases Caused by Basedow's Disease C F Heerfordt, Ugesk f Læger, vol
lxxii, p 87, 1910
- Loss of Sight in Exophthalmic Goitre A Ya Poppen, Vestnik, oftalmol, vol xlviii,
pp 153-156, 1911
- Cerebral Nerve Disturbance in Exophthalmic Goitre, Associated with Bulbar Paralysis
Heuer, Am J M Sc, vol cli, p 339, March, 1916
- Corneal Ulcer of Exophthalmic Goitre J Rogers, ANNALS OF SURGERY, vol lvi,
p 222, 1917
- A Note on Exophthalmos and Limitation of the Eye Movements of Graves' Disease
R Foster Moore, Lancet, vol ii, p 701, Oct 2, 1920

A CONTRIBUTION TO THE STUDY OF FISTULÆ AND CYSTS OF THE NECK*

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THE congenital fistulæ and cysts of the neck, first attracted attention because of their presence in the so-called beauty lines of the neck, particularly if the blemish chanced to occur in a female otherwise normal. At a later period the anatomists and pathologists began to describe them, viewing these embryonic defects as are curiosities. The final stage in the study of these cases was effected in the past thirty years, through the combined development and disclosures of embryology, histopathology and modern surgical technic. A prominent American surgeon recently recommended the study and basic understanding of embryology as one of the foundation stones of surgical training. Few problems in surgery illustrate the latter statement more forcibly than does the development of our knowledge and treatment of the congenital fistulæ and cysts of the neck.

This study is based upon the personal observations and operations of two complete lateral fistulæ, two thyroglossal cysts and fistulæ and one blood cyst of the neck. The rarity of these cases and the difficulty in obtaining specimens makes it anything but easy for the individual surgeon to pass critical judgment. A number of classifications have been advanced by different observers, based on the embryology of this region and the histopathology of serial sections of excised fistulous tracts and cysts. Clinically, however, we must often content ourselves with a diagnosis of cyst or fistula of the neck and try to formulate its course and the underlying pathology of its genesis from our knowledge of embryology. The classification of the congenital fistulæ and cysts of the neck is extremely difficult. No attempt has been made in this contribution to include the numerous classifications of these congenital anomalies, because of the lack of unanimity of opinion and the questionable utility of such grouping. The subject has been extensively studied by many observers and recently by Gaetano, to whom the reader interested in the many classifications is referred.

The persistence of portions of the branchial system of cavities and the persistence of a tract or cells dislocated in the descent of certain viscera may give rise to congenital cysts and tumors.

The development of median congenital fistulæ or cysts is due to the persistence of the median thyroglossal duct. The latter in accord with the usual conception exists as a cord with a central lumen, developing from the

* Read before the Philadelphia Academy of Surgery, January 7, 1924

foramen cæcum of the tongue and opening into the oral cavity. The persistence of the whole or part of the thyroglossal duct leads to the development of a complete or incomplete median fistula.

Wenglowsky has called attention to the fact that the thyroglossal duct as observed in many embryological serial sections does not disclose the presence of a lumen, the examination of embryological specimens of various ages usually fails to disclose a canalized duct. The thyroglossal duct loses its lumen very early in the embryo, the occurrence of this lumen, however, is extremely variable even before 5 mm or about a 22-day embryo. It becomes drawn out to a solid cord, which cord is broken in embryos between 6 and 7 mm (25 to 27 days). It would appear, therefore, that the early lumen of the thyroglossal duct which is inconstant is not a factor of great importance in the development of the thyroglossal fistulæ. Furthermore, it is well to remember that a complete thyroglossal fistula is extremely rare. So much so that some observers have expressed the opinion that complete thyroglossal fistulæ never occur.

The thyroglossal duct as usually observed exists only as an epithelial cord. The rapid growth of the thyroid anlage from the oral cavity to the depth of the neck may take with it as it descends ciliated cylindrical and squamous epithelium from the neighboring structures. The latter cells dislocated from their usual site remain as cell rests. It is the belief of the writer that it is these groups of cells which exhibit a peculiar tendency to canalization and are the foundation for the development of thyroglossal cysts and fistulæ. In support of this theory the following facts are adduced. First, the absence of the lumen in the thyroglossal duct. Second, the existence of fistula with more than one tract. The occasional occurrence of lateral branches communicating with the main tract is well known. Third, the observation of ciliated, cylindrical and squamous epithelium commonly present in one fistula. Fourth, the frequent presence of epithelial cell rests in the body of the hyoid bone, in the lobes of the thyroid and in the thyroglossal duct. Fifth, the great rarity of complete thyroglossal fistulæ.

Lateral Fistula—The occurrence of the lateral or branchial fistulæ as the latter name indicates arise from one of the visceral arches. A large group of these take origin from the second visceral arch. As a confirmation of their development from the second visceral arch is the presence of the inner opening in the tonsillar fossa or in the palatopharyngeal arch. It is well to remember that the third and fourth arches are very rudimentary in man.

Although the second arch is the most common site for the origin of lateral fistula, it is possible for the third and fourth arches to be the nidus for their development. The sinus præcervicalis which is produced by the sinking in of the arches and the included furrows in the lower part of the future neck region usually entirely disappears on coalescence of the bordering parts. Sometimes such union is defective the imperfect closure resulting in a

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permanent fistula situated at the side of the neck known as cervical fistula by means of which communication is established between the pharynx and the exterior of the body. When entrance into the pharynx through the fistula is possible, it is probable that the septum has been destroyed as the result of absorption or the mechanical disturbance following the use of a probe.

Lateral cervical fistulæ may have their origin in the remnants of the thymopharyngeal duct. The embryonic thymus anlage develops as the out-pouching of the third branchial arch, the duct persisting as a fine cord from the third branchial pouch to the thorax. The persistence of a whole or part of the duct with the additional occurrence of an inflammatory process, leads to the development of a complete or incomplete fistula. As evidence in favor of the latter theory as the source of lateral cervical fistula is the following facts: 1. The location of the inner opening behind the arcus palatoglossus and below the tonsillar fossa which is suggestive evidence of their development from the third arch. 2. The common presence of the rests of the thymopharyngeal duct in the cadavers of children, partly as epithelial rests, partly as cysts, and partly as fine canals which are lined by ciliated, cylindrical or squamous epithelium and frequently typical thymus tissue remnants in the fistula.

It is the belief of the writer that the remnants of the thymopharyngeal duct, indicating the course of the caudal migration or descent of the thymus gland from the third pharyngeal pouch to its site in the thorax, offers a tenable explanation for many of the lateral fistulæ of the neck. For like the thyroid, the thymus seems to have a phylogenetic tendency to move toward the thoracic region. Furthermore, while a part of the thymus is of branchial origin, and the organ is commonly classed with the ductless glands, both its finer structure and the course of its growth indicate a close relationship with the lymphoid organs. The lymphoid character of the thymus makes it more susceptible to infection and inflammation without which external fistulæ almost never occur. In both of the writer's cases of lateral fistulæ the inner orifice was located below and inferior to the tonsillar fossa, facts in favor of their origin from the long epithelial tube of the thymus anlage. This conception of the origin of lateral cervical fistula, offers a tenable explanation of the occurrence of the external orifice low in the neck and in the region of the suprasternal or jugular notch.

In furtherance of this theory, it is well to remember that the potentiality of lumen formation or canalization is a normal developmental process in many embryonal tissues. Witness, for example, the early nasolacrimal duct, the ducts of the liver, the ducts of the mammary gland, etc., structures which early in the embryo are solid tissues, the development of the lumen being a later stage of their growth. It would appear, therefore, that embryonal cell rests may under certain stimuli at times undergo canalization or lumen formation resulting in an abnormal canalized tract or cyst. Similarly, we occasionally observe the reverse process, that is, congenital occlusion due to

epithelial proliferation, particularly in the small and large intestine, at times in the nares or choanæ and other structures of the body. The writer has observed cases of congenital occlusion of the ileum, the duodenum and the colon.

Discussion—The fistulæ are usually divided into complete and incomplete, the latter type rarely appearing with only an inner opening. The outer or external fistulous opening may appear intra-uterine or postpartum. The fistulæ almost invariably result from inflammation of the fistulous tract and its lumen, which induces perforation of the skin, the latter constituting the external or cutaneous orifice. It is not uncommon for the cutaneous opening to first appear following an attack of one of the acute infectious diseases of childhood. In two of the writer's cases the external opening first appeared during the convalescence of scarlet fever. The presence of adenoid and lymphoid tissue, particularly in the lateral fistulæ makes these structures liable to inflammatory processes. The external opening may be primary if its origin is from the second arch, the orifice usually lying at the median border of the sternomastoid muscle between the hyoid bone and the sternum. In the median fistula, the external orifice is usually in the midline between the hyoid bone and the thyroid gland. The inner opening of the lateral fistulæ from the second arch may be in the tonsillar fossa, ventral and cephalic to the tonsillar fossa or dorsal to the soft palate in the fossa of Rosenmüller. The presence of the inner orifice below or caudal to the tonsil suggests the origin of the tract from the third arch or the thymopharyngeal duct. The inner orifice of the median fistula when present is in the foramen cæcum of the tongue.

Diagnosis—The diagnosis is usually easy to establish. The patient presents a small cutaneous opening discharging a serous or seropurulent exudate. The amount of discharge varies from 1 drop to 1 cc daily. Frequently there is a co-existent eczema of the skin surrounding the external orifice. In the lateral fistulæ and at times in cases of median fistulæ or cysts, the tract can frequently be palpated as a distinct vertically coursing cord in the neck. If the outer opening is elevated on swallowing, it usually means a complete fistula. Less commonly elevation of temperature and difficulty in swallowing are among the symptoms present. The injection of one of the various coloring fluids such as methylene blue is helpful not only for the purpose of diagnosis, but also as an aid in outlining the extent and course of the tract. It is well to remember, however, that the fistulæ usually become friable, small and attenuated as they course cephalically. The use of a fine probe is usually not advisable, (1) because of the infection present. The most common complaint which induces these patients to seek surgical aid is the presence of infection or retention of secretion (2) the danger of false passage, (3) practical impossibility of traversing the upper limit of the tract, (4) danger of injury to important neck structures. The presence of epithelial cells in the secretion is in the favor of fistulæ and is evidence against a broken-down tuberculous gland as a cause of the cutaneous opening. Its congenital origin and their hereditary tendencies are additional confirmatory data.

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Topography A fistula of second branchial arch which is by far the most common is covered by skin, superficial fascia, platysma and the superficial layer of the deep fascia of the neck. It courses along the medial border of the sternomastoid muscle to the greater corner of the hyoid bone. From the latter site it passes over or superficial to the common carotid artery, and then if development is normal between the internal and external carotid arteries and ventral to ninth and tenth cranial nerves to the side of the pharynx. At the level of the greater cornu of the hyoid bone, the fistula takes a turn medial and dorsal, and it is only to the latter site that a fine probe can be passed. Similarly the injection of one of the colored identifying fluids, usually does not pass beyond the greater cornu of the hyoid bone. In one of the writer's cases, however, the injected color fluid appeared in the pharynx following its introduction at the external aperture disclosing definitely a complete type of fistula. A fistula of the third visceral cleft lies between the common carotid artery and the vagus as well as between the glossopharyngeal and the superior laryngeal nerves. Fistulæ of the fourth visceral cleft must bend around the subclavian artery on the right side and wind around the concavity of the aortic arch on the left side. The *median fistulæ* course over the sternohyoid and sternothyroid muscles and are usually related to the posteroinferior surface of the body of the hyoid bone on its way to the foramen cæcum. The fistulæ may, however, terminate at this point, or may even pass through the body of the hyoid bone to disappear in the musculature of the floor of the mouth. The tract becomes attenuated, small and friable in its cephalic portion, and it is usually impossible before operation to know accurately its cephalic limit.

Treatment The majority of the operations for the cure of the congenital fistulæ of the neck are unsuccessful unless the epithelial-lined tract is completely removed. The inner opening is cut around if possible and sutured. The utilization of methods of treatment other than surgery, only results in recurrences.

The injection of bismuth for X-ray and introduction of methylene blue immediately before operation are helpful in outlining the course of the fistulous tract.

The median or thyroglossal cysts were excised by the method advocated by Gaetano and Sistrunk. As a rule the cyst below the hyoid bone is easily excised, but cephalic to the hyoid the tract becomes friable and small, so that it is easily broken off and consequently difficult to remove. As Sistrunk and others have stated, better results are obtained when no attempt is made to isolate the duct above the hyoid bone. Therefore, instead of attempting to isolate the duct, the tract is cored out, removing with the duct the tissues surrounding it for a distance of about one-eighth inch on all sides between the hyoid bone and the foramen cæcum in a line. At the level of the hyoid bone, the tract as noted above may pass through it or it may be found passing in front or behind it. The muscles attached to the centre of hyoid are separated and a quarter of an inch of the hyoid bone is removed. The dissection

is continued in a dorsocephalic direction toward the foramen cæcum, removing with the duct a portion of the hyoid bone a portion of the raphe joining the mylohyoid muscles and portion of each geniohyoglossus and the foramen cæcum. The opening in the mouth is closed and several sutures used to approximate the geniohyoid muscles. The tissues surrounding the cut end of the hyoid bone are then drawn together by chromic catgut sutures so as to approximate the ends of the bone. A small rubber drain is introduced to this point and the skin closed around it. In two cases in which the above procedure advised by Sistrunk was carried out, there were no ill-effects following the removal of the hyoid bone or any serious infection following the opening made into the mouth.

Lateral Fistula — Similar to median fistulae can only be successfully cured by radical excision of the suture tract. Here again it is necessary to bluntly dissect out the tract particularly in the region of the great vessels. In cases where the tonsillar fossa is suspected as the site of the inner orifice, a tonsillectomy should precede the excision of the tract. The lateral fistulae similar to the median fistulae may be dissected out easily and without difficulty, in the caudal part of their course, *i.e.*, below the digastric muscle. But above this the tract may be adherent and is in close relation to the important neck structures. In some of the fistulae it is impossible to dissect them away without destroying important neck structures, a procedure which the primary condition does not justify.

In one of the writer's cases the external carotid artery was distinctly behind the fistula and had no attachments to its wall.

Von Hacker's method consists in the inversion or invagination of the fistulous tract into the oral cavity and the inverted portion excised.

Complete inversion of the fistulae can only be successfully carried out (1) when the fistulous tract is movable, (2) when adhesions are absent to the surrounding structures. At times the presence of an excessive amount of connective tissue muscle cartilage or developing bone in the wall of the tract may interfere with the successful inversion of the sac. Von Hacker, Helferich, Whitacre and O'Dowd, and in one of the writer's cases the procedure was successfully carried out. For adherent cases König's method seems well suited. The operation was performed successfully in one patient as follows. The dissection of the entire fistulous tract was carried upward to a point immediately above the digastric muscles and separated from its attachment to the pharyngeal muscle. The blunt end of a probe was passed cephalically from the upper end of the operative wound in the neck into the mouth to the inferior anterior border of the right tonsil. A small incision was made in the oral mucous membrane over the probe. The distal end of the fistula was tied to the open end of the probe with silk and the probe drawn in the mouth the fistulous tract following was drawn into the oral cavity until it seemed to be on a stretch. The everted portion of the fistulous tract was cut away and the portion remaining was fixed to the mucous membrane of the mouth by two chromic catgut stitches. The fistula now has both

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openings in the mucous membrane, the inner end in Rosenmuller's fossa and the other in front of the tonsil instead of the skin. There is thus produced an open canal beneath the oral mucous membrane in which retention cannot take place. Traction is made on the tract until it seems to fray away. Caution must be exercised not to exert excessive traction on the fistula in the act of inversion because of the danger of tearing it away. The latter accident occurred in one of König's early cases.

The cases forming the basis of this paper were operated upon by the writer in the service of Doctor Nassau, at the Mt. Sinai Hospital, and I am indebted to Doctor Nassau for his courtesy in allowing me to report them.

BIBLIOGRAPHY

- De Gaetano Archiv o Italiano di Chirurgia, vol. iv, October, 1921, fasc. I, p. 264.
Sistrunk ANNALS OF SURGERY, 1920, vol. lxxi.
Wenglowsky Ueber die Halsfisteln und Cysten Archiv f. Klin. Chir., 1912, vol. xcvi, p. 151.

POST-OPERATIVE PULMONARY COMPLICATIONS*

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A REVIEW of the previous Annual Orations before this Academy finds the subjects following two definite lines, (1) the philosophical and (2) the technical. In choosing a subject for this occasion we promptly eliminated the philosophical. Your intimate knowledge of our work and limited years of experience would embarrass any attempt upon our part at the retrospective or perspective. The technical subjects presented have been based upon original research or have visioned new fields in surgery. Again we were forced to admit our limitations. Our final decision has been to discuss such a commonplace subject as post-operative pulmonary complications and we hope you will bear with us in the presentation of one of our hobbies.

Our interest in post-operative pulmonary complication began when in charge of a department of anaesthesia. This was at a time when all such complications were considered the direct result of the anaesthetic and incidentally the skill of the anaesthetist. The resentment of youth may have been the real incentive which stimulated an investigation of this problem at that time. Although the work was never published it served to convince us, and a few of the staff surgeons, that there were many etiological factors other than anaesthesia concerned in these embarrassing complications. Curiously anaesthetists are still passively accepting this easy explanation. Cutler¹ states that it is unfortunate that anaesthetists and anaesthesia should bear the blame of pulmonary complications following anaesthesia and operative procedures, when the facts seem to exonerate both in the majority of cases. This certainly is in accord with the experience of many surgeons.

The literature of the last few years has shown a very rapid increase in the incidence of these complications, and the present figures are such as to demand a serious consideration of the problem by both the surgeons and the anaesthetists. Undoubtedly this increase in the morbidity is largely, if not entirely, due to more careful physical examinations and better records so that the following figures more nearly represent the situation than any of our older statistics. Cutler in two of his reports, which were three years apart, shows a marked increase in his later group. It now seems well established from many sources that 1 in every 50 patients operated upon develops a pulmonary complication and one in every 150 to 175 developing such complications die, a morbidity of between 3 and 4 per cent and a mortality of about 0.6 per cent. Pepper,² McKesson,⁴ Cutler and Hunt,³ Norris.⁵ With such figures the value of our generally accepted anaesthetic risks either

* Annual Oration in Surgery, 1923 before the Philadelphia Academy of Surgery

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1-16,000, chloroform 1-3000, ethyl chloride 1-12,000, nitrous oxide 1-300,000, appear useless in estimating operative risks

We can no longer regard all post-operative pulmonary complications as post-anæsthetic sequelæ, nor assume that the only risk of post-operative pulmonary complication arises in the anæsthesia. Long before the days of the routine use of general anæsthesia we find Norman Cheevers⁶ writing in Guy's Hospital Reports, "that pneumonia is the most frequent cause of



Right

Left

FIG 1—Pulmonary embolus and infarction. Right middle lobe. Symptoms developed on 18th day following a supracervical hysterectomy for uterine myofibroma. Infarcted area triangular in shape with base toward periphery and apex toward hilus of lung. Radiogram taken by Dr D R Bowen, Pennsylvania Hospital Philadelphia. Robert G Le Conte

death after surgical procedures." The literature contains many references to the effect that the incidence of these complications is as great, and many claim greater, with local anæsthesia as with general, though the mortality when following general anæsthesia is slightly higher than in local. Mandl,⁷ Gottstein,⁸ Mikulicz,⁹ Henle,¹⁰ Sauerbrock¹¹

Instead of the anæsthetic being considered the most important factor (and the only one by many) in these complications, its greatest effect can only be contributory, and it should be considered with such other contributing factors as infection (either pre- or post-operative), preexisting lung disease,

old age and debility and the chilling of the body all of which have been so carefully studied by Whipple

It is now generally accepted that the site of the operation and the character of the procedure are the constant and all-important factors. The relation of the operative field to the diaphragm bears a direct relation to post-operative pulmonary complications and statistics show this relationship is the most constant of all etiological factors. Cutler and Hunt² give perhaps the highest

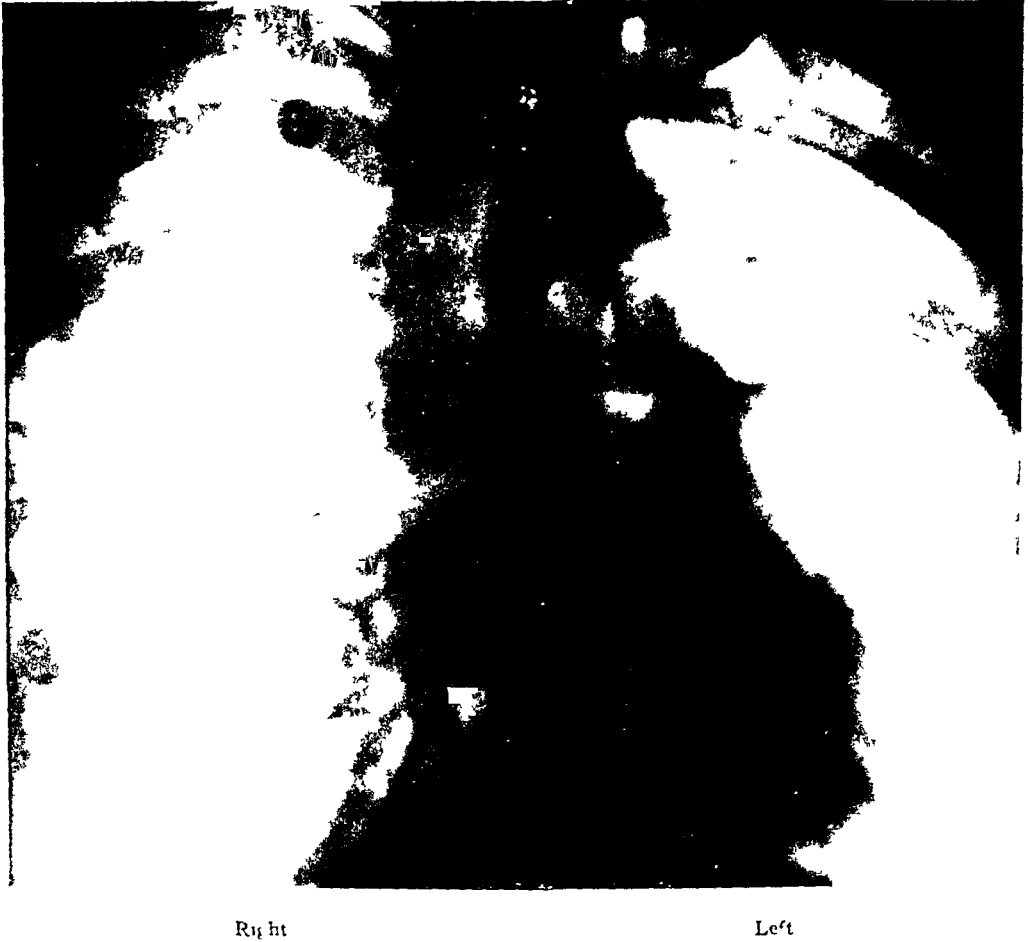


FIG. 2.—Spontaneous pneumothorax with compression of the right lung occurring in a patient with chronic pulmonary tuberculosis. Note the character, size and position of the shadow cast by the compressed lung. Compare the density of the shadows in the right thorax containing free air in the pleural cavity with that of the left in which air is confined within the lungs. The diaphragm is markedly depressed because of increased intrathoracic pressure. Radiogram taken by Dr. D. R. Boyce, Pennsylvania Hospital, Philadelphia.

figures. In a group of 63 cases of post-operative pulmonary complications 43 or 68 per cent. followed laparotomies. Mandl¹² reports a general morbidity of 8 per cent. following operations upon other parts of the body and 14.5 per cent. after abdominal operations. Norris⁷ a general morbidity of 11 per cent. and 4 per cent. after laparotomy. Pasteur¹³ a morbidity of 1.8 per cent. after operations upon the urinary bladder while there was 13.4 per cent. after operations upon the stomach and 11.0 per cent. following operations upon the liver and gall-bladder.

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In addition to the necessity of abandoning our complacent acceptance of anaesthesia as the sole cause of post-operative pulmonary complications, the work of Cutler also makes it necessary for us to abandon the all-inclusive diagnosis of "pneumonia" for these complications. With the more accurate physical examinations his work has stimulated there is a surprising decrease in this diagnosis of post-anaesthetic pneumonia. In the same group of sixty-three cases, previously referred to, Cutler demonstrated thirty-two as being caused by pulmonary embolism and infarction. Rupp¹⁵ found at autopsy in 13 000 post-operative cases, 5 per cent having demonstrable emboli and infarctions in the lungs. In our immature work years ago, embolism and infarction were found very frequently post-mortem, but their significance was not appreciated at that time. To Cutler belongs the credit of demonstrating this condition and calling attention to it. The onset is usually abrupt, the physical signs are characteristic and febrile changes are sudden, except when the emboli occur in an aseptic field. In septic emboli the clinical picture may simulate pneumonia, or lung abscess may result. When the clot is sterile the resulting changes are characteristic of minor pulmonary infarcts. "From the second to the fourth day there is usually sudden pain on respiration followed by expectoration in about one-half the cases. The sputum is often blood-stained." "Preceding the onset of this symptom there is usually a rise in pulse, temperature and respiration, and with the pain these may increase." "Immediate auscultation of the chest reveals one or more small areas covered with fine râles over which there is some impairment of breath sounds and, if the focus is sufficiently large, some change in fremitus." "When pain is present a friction rub may be the most distinct sign." "It must be remembered that a friction rub results only when the area of the lesion reaches the periphery of a lobe." It also must be understood if we are to recognize all these lesions that some in the smaller thrombi do not cause sufficient pathology to give those physical signs. Cutler and Hunt advise Rontgen-ray studies as of the greatest value. Invariably they appear as small flurries of consolidation, which from time to time will take the form of a cone-shaped shadow with its base out. Rontgen-ray studies, moreover, should be made immediately, since these lesions chiefly represent merely a change in blood distribution and soon clear up. A definite resolution is complete as a rule within six to seven days. Of course, this process will vary according to whether the emboli are aseptic or septic and also upon the size of the embolus and the vessel in which it lodges. Thus you sometimes will have definite massive areas of infarction and in the lantern slide being shown (Fig 1) there was pulmonary infarction which was distinctly demonstrable in the X-ray. In conclusion Cutler and Hunt with many others now believe that embolism from the operative field is the primary factor in all post-operative lung lesions and that all others are secondary and contributing factors only. Embolism is used in the sense of the transfer of small particles, which may or may not be sterile, from the operative field to the lungs, by either the lymphatic or blood channels.

It is our belief that pulmonary embolism and infarction will be found in a much larger proportion of post-operative pulmonary complications than has been reported up to the present time (Cutler 50.7 per cent) as the character of our physical examinations improves. The importance of this phenomenon has been admirably presented by Cutler from whose reports we have freely quoted, and need take no more of our time.

There is, however, another post-operative pulmonary complication whose

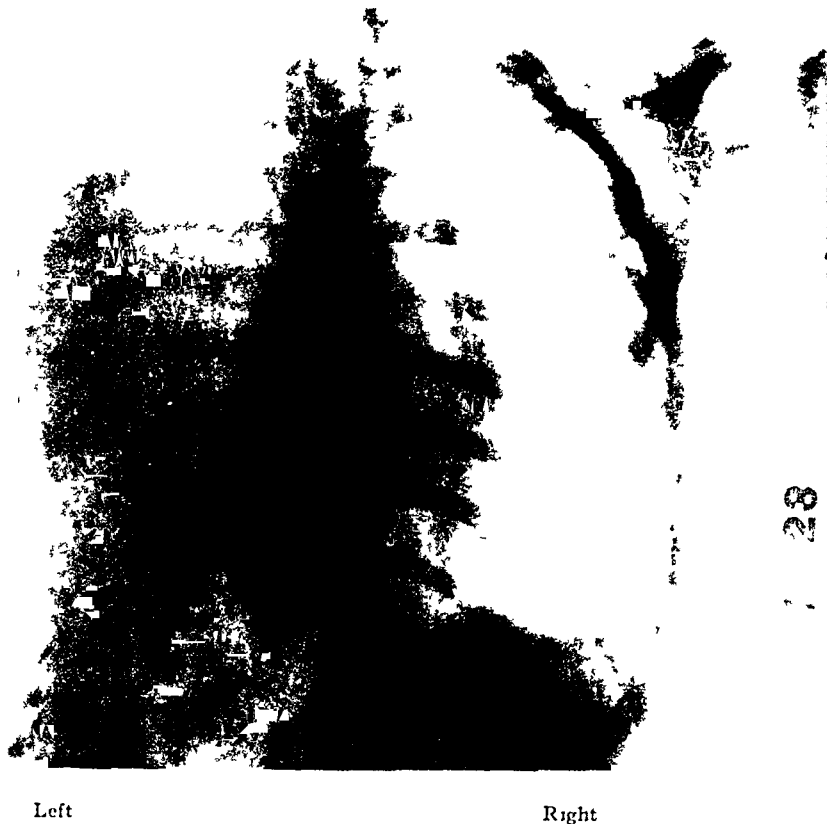


FIG. 3—Acute massive streptococcal empyema in a child of 11 years. Note the uniform opacity of the shadow cast by the fluid. The great lateral displacement of the heart to the opposite side and the downward displacement of the diaphragm on the affected side resulting from increased intrathoracic pressure. Case of D. R. Reister and Graeme Mitchell, Children's Hospital, Philadelphia. Radiogram taken by Dr. Ralph Brorier.

incidence is probably constant and may be as great as embolism and infarction, to which we wish to devote the rest of the time. *Post-operative Massive Collapse of the Lungs*.—Attention to this phenomenon was first called by Pasteur in a paper entitled "The Respiratory Paralysis after Diphtheria as a Cause of Pulmonary Complications."¹¹ In 1910,¹² he stated that there was a close connection between the mechanism producing collapse of the lower lobes of the lung in post-diphtheritic paralysis and that underlying the collapse attacks following operative procedures. In 1914¹³ he records a group

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of 201 post-operative lung complications, in which he recognized 12 cases of massive collapse or a proportion of 6 per cent. Since this report 28 cases have been recorded in literature to which we add 2, making a total of 42. We feel that a general recognition by surgeons of this possibility and a systematic search will greatly increase this incidence of 6 per cent suggested by Pasteur. That in the last year we have encountered two definite cases and a possible third would suggest this. In several of the clinics in this country, routine X-ray examinations of the lungs are being made at the present time after all major operative procedures.

Undoubtedly varying degrees of pulmonary collapse occur and Briscoe¹⁸ states his belief that the large majority of post-operative pulmonary symptoms are entirely due to varying degrees of pulmonary collapse. Pasteur¹³ takes exception to this definition of the condition and would have us confine the term collapse to the condition of massive collapse, in which the lung is completely deprived of its air. When not completely airless, he suggests the term partial deflation. This seems to us unnecessarily confusing. Further, it would also exclude its constant presence as a modifying and often a determining factor in such other conditions as pulmonary embolism and infarction. To us its importance as a post-operative factor lies not in the occasional massive collapse we encounter, but that it always occurs in varying degrees after operative procedures, trauma and other conditions of which we will speak later. However, only massive collapse of one or more lobes has been recognized up to the present time. A brief recital of our own cases will probably present the phenomena in the clearest way and make possible a detailed discussion. The usual phenomenon is as follows. A few hours to as long as seven days after a surgical operation, usually abdominal, the patient suddenly presents the symptoms of a catastrophe. It is impossible at first to localize the condition, the thorax after a short time engages one's attention. Acute dilatation of the heart, coronary embolus, pulmonary embolism or pulmonary infarction are the common preliminary diagnoses. A more careful examination may suggest pneumothorax. There is usually only a moderate febrile reaction unless there is coincident infection. There may or may not be an increase in respiratory rate, sometimes reaching 30 or 40. A pulse rate and a respiratory rate directly related to the febrile reaction are to be expected, but otherwise they are remarkably undisturbed. The physical signs of the chest are perhaps the most characteristic findings. Upon inspection there is diminished or even absent respiratory movements of the chest wall over the affected area. The intercostal spaces apparently are hollow and very much narrower than upon the normal side. The cardiac impulse is seen displaced toward the affected side (just the opposite to that one finds in a pneumothorax or effusion). The apex has a tendency to tilt outward and upwards, so that the apex of the impulse of the heart beat may often be felt in the axilla (this is particularly true when it occurs on the left side). In one of our cases, right-sided, it reached the right anterior axillary line and was first diagnosed by the house officer as a case of dextrocardia (a very

frequent preliminary diagnosis) The dome of the diaphragm on the affected side is abnormally high and immobile The high diaphragm is readily detected by percussion in the left-sided cases On the right side, however percussion is not so reliable but X-ray examination yields definite evidence both as to its position and immobility These symptoms are common to all cases, in other words, physical symptoms which indicate a falling into the pleural space of the surrounding structures, namely, those of the mediastinum and



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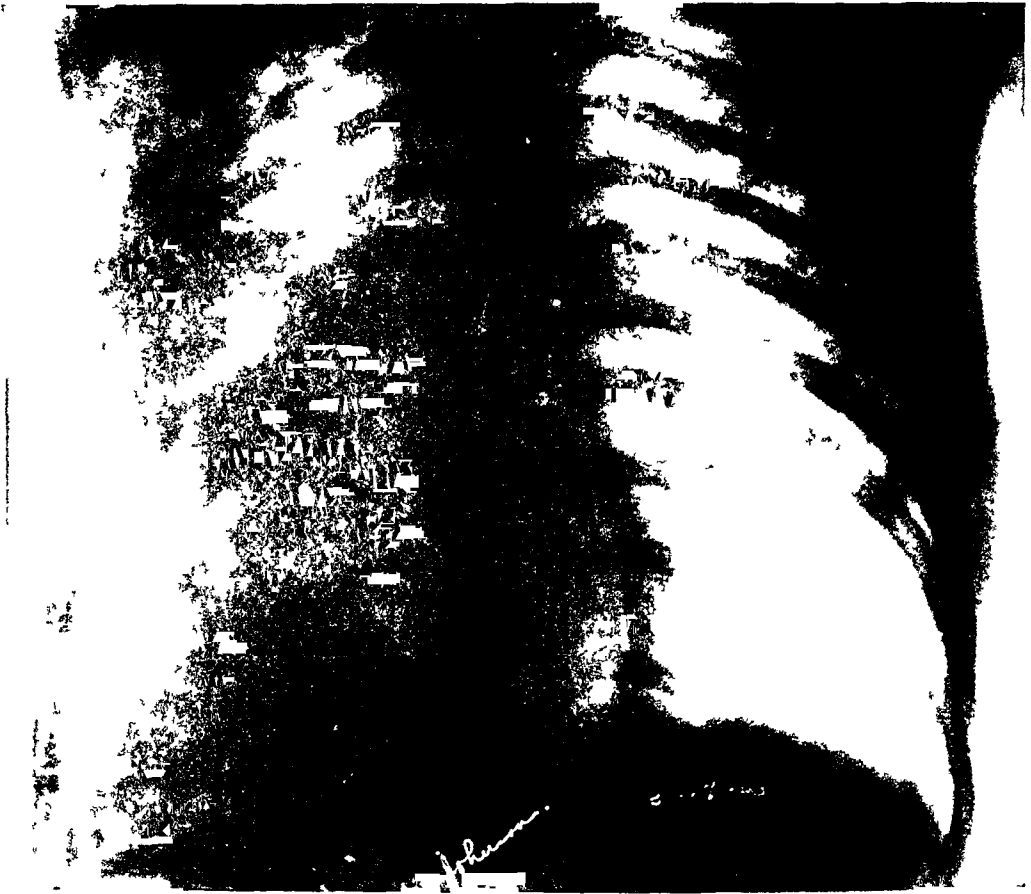
FIG. 4.—Same patient as Fig. 3 forty-eight hours after thoracotomy by intercostal incision. Left lung still unexpanded after its compression. Heart and diaphragm returning to normal positions. Radiogram taken by Dr. Ralph Bromer. Children's Hospital Philadelphia.

diaphragm. A further study of physical signs divides the cases into two distinct groups. In both dulness on percussion is present over the affected side and may extend as high as the clavicle, this is usually posterior but may be anterior. It corresponds to the area of the collapsed lung. The pleural space unoccupied by the collapsed lung is hyperresonant and may be tympanic. In one group the vocal fremitus is diminished or absent, while in the other it is increased. In the group where the vocal fremitus is diminished or absent the breath sounds are also diminished or absent, but when increased the breath sounds are loudly tubular or amphoric in character and broncho-

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phony and pectoriloquy are also extremely well marked. This difference in the physical signs is probably dependent upon the patency of the bronchi. When there is a large proportion of air in them there is an increase in breath sounds which are loud, tubular, amphoric in character and bronchophony and pectoriloquy are present. One will readily see that the physical signs in the lungs are those commonly attributed to pneumonic consolidation but, if anything, the signs are even more marked, especially the tubular and amphoric character of the breath sounds. One of the main reasons why massive collapse of the lungs is so frequently overlooked, is that the tubular breathing is so extraordinarily well developed that its mere presence is at once regarded as conclusive evidence of the existence of pneumonic consolidation. Due regard to the other signs, namely, cardiac displacement, should make the diagnosis clear. In the type of case where there is dullness on percussion and diminished or absent vocal breath sounds the diagnosis is more difficult, unless adequate stress is laid upon the displaced position of the cardiac impulse. Broadly speaking, this type of case in which the bronchi are not patent is usually found in the early stages of the condition, while the patent bronchi are found in the later stages of expansion. In one of our cases the breath sounds and the transmitted voice when heard through the stethoscope were almost deafening. Râles and adventitious sounds may be present but are often absent throughout the entire process. Again they may be abundant, especially in the latter stages of the disease when the lung is reexpanding. When, in rare cases, inflammatory complications develop in the collapsed lung, the presence of adventitious sounds will coincide with the lesion developed, but they are not the essential signs of massive collapse. The cardiac displacement is the most characteristic physical sign and the condition cannot be diagnosed with certainty unless this sign is present. This marked displacement of the heart is rarely if ever accompanied by cardiac murmurs. Though the displacement is mainly lateral, in cases where the whole lobe or the upper lobe is involved the displacement is also upward, so that the maximum impulse may be felt in the third interspace or behind the rib. The Röntgen-ray corroborates all these physical signs and will be of the greatest aid when the lesion is on the right side. The lung shadows on the affected side will be more or less opaque and suggest a purulent pleural effusion in its degree of density. The extent and density of this shadow will, of course, vary with the amount of lung involved and the degree of airlessness. As the air returns this opacity gradually disappears, the opposite to a pleural effusion. Instead of an increased pleural pressure, as in pleural effusion, pushing away the heart and diaphragm, there is a negative one and the heart and diaphragm encroach upon or are drawn into the pleural space. The displacement of the heart toward the affected side is usually very marked and the dome of the diaphragm ascends to an unusual degree. The X-ray interpretation in one of our cases was a subdiaphragmatic abscess. Rose-Bradford¹⁹ says, "that its being a complication of other diseases and injuries probably explains its being so frequently overlooked, its physical signs usually

being attributed to other causes" There is a surprising dearth of references to this condition in the literature of general medicine Norris and Landis²⁰ speak of massive collapse of the lung as a complication of pneumonia Rose-Bradford²³ refers to it as a possibility in pneumonia and reports an autopsy in one case where there was a collapse of the lower lobe and pneumonia in the upper lobe Tidy²¹ reports an undoubted case of a massive collapse of the entire right lung in a healthy man twenty-nine years of age who was suddenly



Right

Left

FIG. 5 — Post-operative massive collapse of right lung. Symptoms developed 72 hours after the removal of a gangrenous perforated appendix and drainage of an abscess around the cæcum. This radiogram was taken 48 hours after onset of symptoms. Note density of shadows in the right thorax. The absence of heart shadow on the left side and the elevation and shape of the right diaphragm resulting from decreased intrathoracic pressure. Radiogram taken by Dr. Henry Thissell, Germantown Hospital.

taken without any previous illnesses or premonitions with pain in the right chest. Upon entering the hospital forty-eight hours later he had the typical symptoms of a massive collapse, which disappeared entirely at the end of six weeks. The only etiological factor which Tidy could find was the immobilization of the lower right chest and the right diaphragm. This inhibition of the respiratory muscles Tidy felt was due to the pain probably caused by a pleurisy and the inhibition or arrest of respiration was followed by a collapse of the lung. Collapse of the lung in the newborn and in infancy

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has received considerable attention Reynolds²² speaks of airlessness in the lungs of newborn children and calls the condition apneumotosis. He was convinced at this early date, 1871, that the distribution of affected lobules was in direct relation to bronchial tubes, lobules supplied by one particular bronchial tube often presenting characteristic lesions, while lobules supplied by closely adjacent bronchial tubes may be perfectly healthy. In his mind this precluded the possibility of it resulting from an infection spreading by simple continuity. But literature contains the greatest number of references to pulmonary collapse after diphtheria as described by Pasteur¹³. The military surgeons supply the next largest group of cases in those of traumatic origin, following unilateral wounds of the chest (penetrating or non-penetrating) non-penetrating wounds of the abdominal wall and occasionally wounds of the buttocks, pelvis and thigh. There has been an increasing interest of late in its relation to operative procedures.

Varieties As the clinical forms of massive collapse are quite similar irrespective of the variety, it will be possible to consider the subject with reference to the varieties merely from an etiological standpoint. Thus the clinical forms irrespective of their etiology may be (1) lobular, (2) lobar, or (3) total in distribution. In the lobular or partial type the upper or middle third of one or both lower lobes is the part most frequently affected. In the lobar type one or both lower lobes are usually affected. In the total variety the whole lobe is in collapse. Massive collapse not only varies in the extent of the area involved but also in the degree of airlessness, and it is this variation in the amount of air which accounts for weak or absent breath sounds at times and at others loud tubular or amphoric breathing. The similarity of the phenomena of collapse of the lung in post-diphtheritic paralysis to that found so frequently in the misnamed post-anæsthetic pneumonia was first called attention to by Pasteur¹³ in 1914, and has aroused considerable interest, the English literature contains excellent clinical and experimental observations. Rose-Bradford²³ gave the first exhaustive discussion of the phenomena which he had encountered so frequently as a result of gunshot wounds of the chest. That it was not fully recognized by him until after very extensive experience with chest cases probably means that it is really much more frequent than he found. He reports his belief that it occurs in fully 10 per cent. of all non-penetrating injuries of the thoracic wall. The most readily recognized and certainly the best for study are those cases which are associated with non-penetrating wounds of the chest wall and especially those which curiously occur on the side opposite to that injured. He did not have the opportunity of seeing patients who had wounds of other portions of the body, his work being confined to those of the chest, but as we have elsewhere stated he had knowledge of its occurrence following abdominal wounds, wounds of the pelvis, buttocks and lower extremities, but no cases with wounds of the head or upper extremities. The varieties encountered in thoracic wounds he divides into homolateral, contralateral and bilateral, all of which may be lobular, lobar or total. The contralateral variety of

massive collapse involving the whole of one lung is a very remarkable condition, more especially as in many cases the wound on the opposite side is not only non-penetrating but most trivial in character, causing no fracture nor indeed any extensive injury of the chest wall. Personal communications from a number of American, English and French medical officers in the late war has given evidence that this phenomena was frequently recognized but unexplained. In war, of course, the determination of its earliest establish-



Right

Left

FIG. 6.—Post-operative massive collapse of right lung. Radiogram taken 4 days after that shown in Fig. 5. Note the re-inflation of the upper and lower lobes of the right lung with air. Outline of heart clearly shown with right border to right of mid-clavicular line. Right diaphragm still elevated. Radiogram taken by Dr. Henry Thissell, Germantown Hospital.

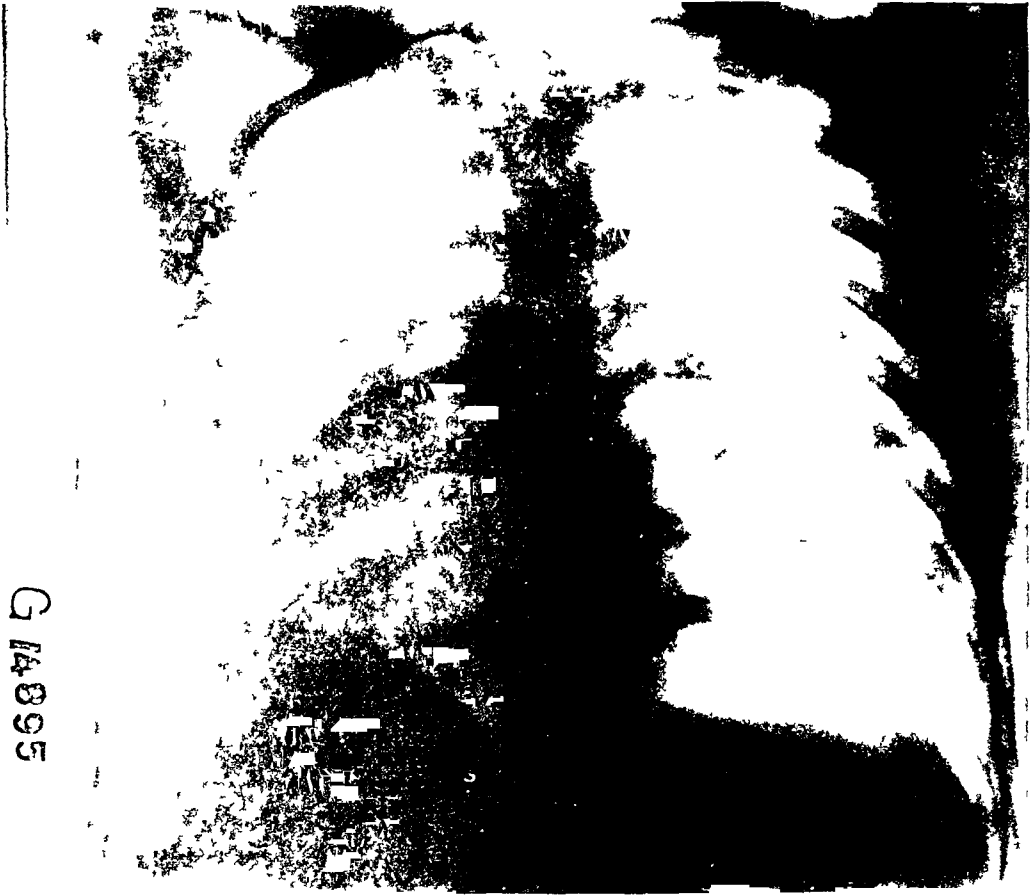
ment after the receipt of the wound was quite impossible, but Rose-Bradford reports that he saw a case that was completely established with total massive collapse of one lobe fourteen hours after the receipt of the injury. Although all this has a definite surgical bearing, the part which is germane to the present discussion is its association with operative procedures.

Etiology.—For a condition which we have seen may develop as a congenital abnormality as in the aponeumotosis, or atelectasis of the newborn, which may develop spontaneously, apparently being caused by an acute pleurisy, which follows post-diphtheritic paralysis of the respiratory muscles,

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which follows infection of the lung and of the bronchi themselves, as pneumonitis and purulent bronchitis, which follows non-penetrating traumatic injuries of the chest and of the adjacent abdominal wall, buttocks, pelvis and lower extremities, and that has an approximate incidence of about at least 6 per cent in abdominal operations, for such a condition it would seem difficult to find a common etiological factor. This is apparently true, for in the discussion of its etiology there is at the present time no definite consensus of opinion. Various theories, of course, have been offered. That it can be caused entirely by paralysis of the diaphragm or respiratory thoracic muscles is proven by Pasteur in his post-diphtheritic phrenic paralysis. Pasteur in his article¹⁷ quotes experiments of Martin and Hare in which lungs were found collapsed in cases of death occurring in animals as the result of section of both phrenic nerves. Briscoe,¹⁸ experimenting with normal rabbits, divided the phrenic nerve on one side of the neck and was able to obtain varying degrees and location of pulmonary collapse following this procedure. Curiously the deflation was not limited to the same side as the paralyzed half of the diaphragm. The opposite lung was affected in almost the same area and frequently to a greater degree. He also was unable to obtain, which is rather important in view of some of the theories, any evidence of a reflex paralysis or arrest of one-half of the diaphragm as the result of intra-abdominal irritation. Of course, as he said, these conditions were all tried upon normal animals and not ill ones as in the cases of Pasteur. He reports three observations upon cases of spinal paralysis, due to injury and paresis, in which there was a complete paralysis of the cord high up. In these cases he found complete deflation of the pulmonary lobes. Schroeder and Green²⁴ state as the result of clinical and experimental work with animals and birds: (1) That the diaphragm is not an essential muscle of respiration. (2) That the nerve supply is practically entirely dependent upon the phrenic nerves. (3) That after section of the phrenic nerve the intercostal nerve supply is sufficient to carry on the action of the diaphragm. (4) That section of one phrenic nerve produces collapse of the lower lobe of the lung on the affected side. This, of course, was not in agreement with the work of Briscoe. (5) The destruction of one phrenic nerve in man, is not necessarily fatal. Pearson-Irvine²⁵ report a case of diphtheritic paralysis of the thoracic muscles (auxiliary muscles of respiration) with an overacting of the diaphragm. In this case there was a definite collapse of the upper lobe of the lung. He is perhaps the first to suggest that this collapse of the lung is not only due to lack of movement of the thoracic cage but also to some extent to a paralysis of the muscles of the bronchial tree. Lichtheim²⁶ produced a definite collapse in the lung tributary to bronchi in which he had placed laminaria plugs. These experiments were performed with rabbits. This theory of bronchial obstruction is one which has appealed to many men. Dingley and Elliott²⁷ suggest that in man consequent to immobilization of the thoracic wall and diaphragm, irrespective of its cause, secretion collects in the bronchioles and even in the larger bronchi sufficient to prevent the egress

of air and leads to a gradual absorption of the aveolar air by the pulmonary circulation and ultimate collapse and airlessness of the lung tissue. We have been able to confirm this by autopsy in one of our cases, a case of a strangulated femoral hernia which was operated upon under local anæsthesia. The collapse apparently occurred on the third day following the operation. This was demonstrated by X-ray. On the fifth day he had definite signs of pneumonic consolidation (lobar) of the upper right lung and he died on the



Right

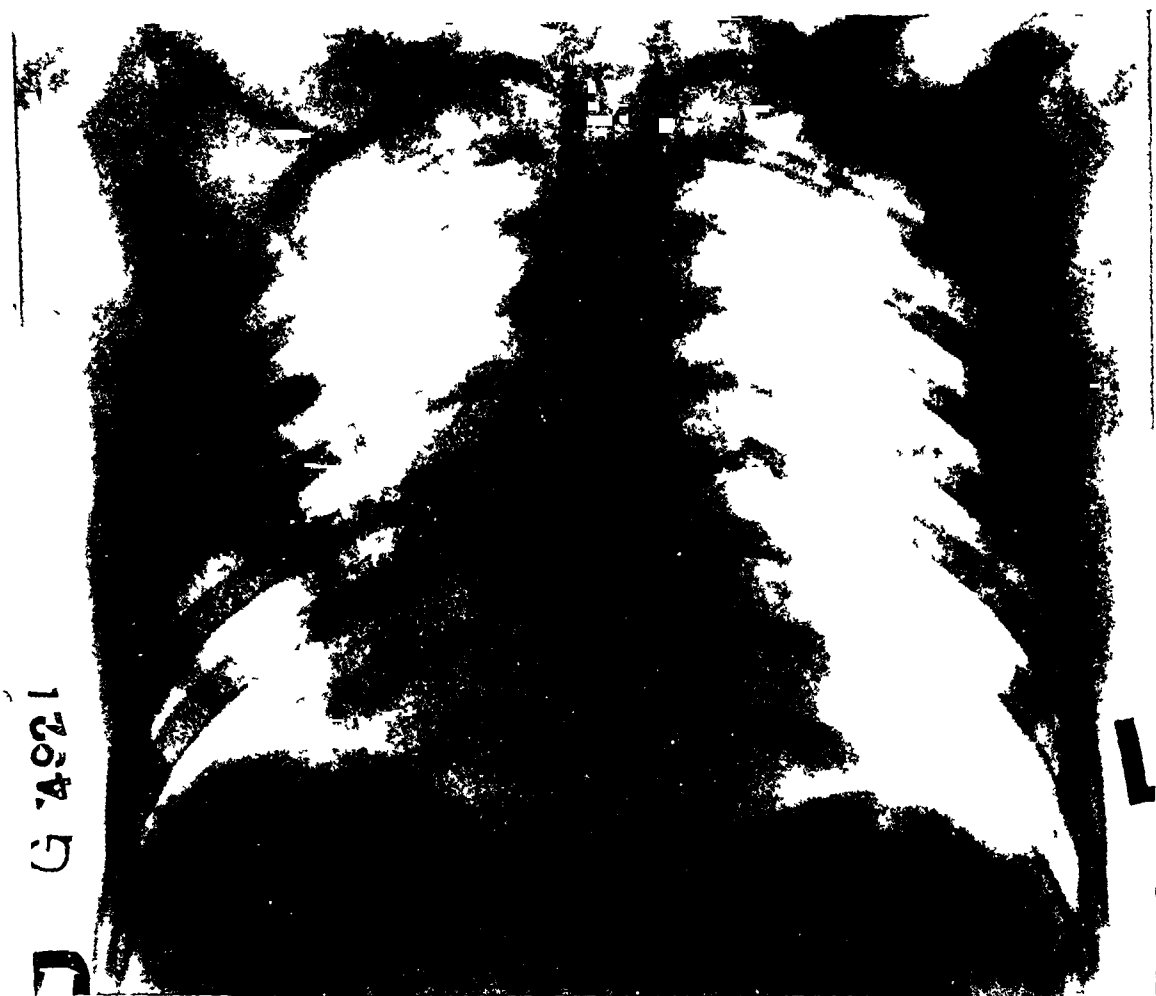
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FIG 7—Post operative massive collapse of right lung. Radiogram taken 5 days after that shown in FIG 6. Note re-inflation of the right upper and lower lobes with air, middle lobe in partial collapse, diaphragm still elevated on right side. Heart in the right thorax. Radiogram taken by Dr Henry Thissell, Germantown Hospital.

tenth day. Autopsy showed a definite collapse of the lower right lobe with a purulent pneumonia in the two upper lobes. In tracing the bronchus of the lower lobe a definite plug of purulent mucus was encountered which blocked the tissue tributary to it. Grailey and Hewitt² suggest the curious explanation that the tapering funnel-like character of the bronchial tree would necessarily have an action upon the obstructing plug similar to that of a ball valve. The effect of inspiration being to propel the plug towards the alveolar tract, and jam it when it arrives at a bronchiole whose calibre is less than that which it originally occupied and during expiration it would be dislodged.

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allowing the air to escape from the alveoli. Rose-Bradford is inclined to feel that obstruction does not play an important rôle. He emphasizes the fact that it is well-known that insufficient expansion of the chest, however produced, is capable of causing collapse of various degrees in the underlying lung. In some instances a constrained posture or a prolonged recumbency is sufficient to cause quite extensive collapse, involving, for instance, one lobe of the lung. Briscoe¹⁸ agrees in part with this statement, and after his experimental work



Right

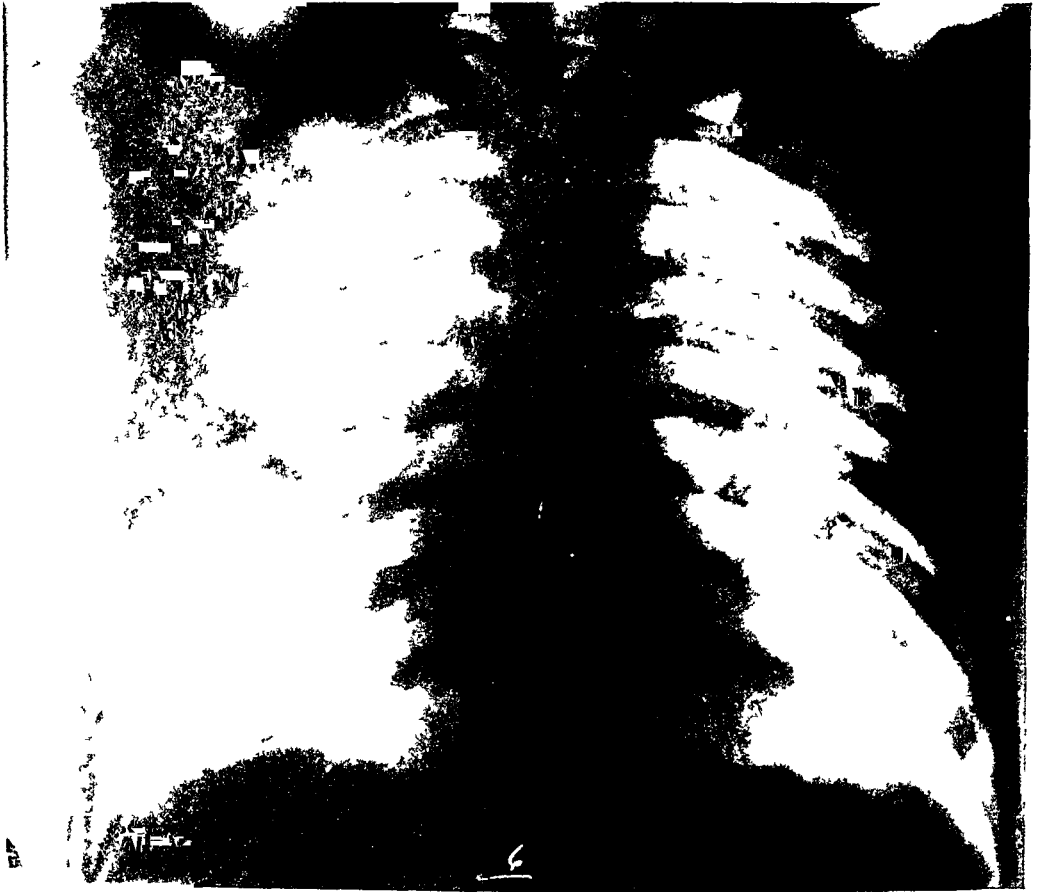
Left

FIG 8—Post-operative massive collapse of right lung. Radiogram taken 5 days after that shown in Fig 7. Note the amount of air in upper and lower lobes of right lung is almost normal, middle lobe still in partial collapse. Heart has moved toward left. Level of right diaphragm has descended and is normal. Radiogram taken by Dr Henry Thissell, Germantown Hospital.

with animals and more or less analytical study of posture and respiratory movements of various individuals, says that massive collapse of the lower lobes of the lung is a natural sequence of prolonged quiet breathing in the supine position in such people as do not use the abdominal muscles to fix their chest. He suggests that it is circulatory in its actual beginning, that as a result of the inhibition of the respiratory muscles an œdema of the pulmonary tissues develops following which collapse takes place. Rose-Bradford¹⁹ also feels that in some unexplainable way this condition is brought about by reflex action, particularly when it follows injury on the opposite side of the chest,

upper abdomen and lower extremities, though, as has been stated, Briscoe was absolutely unable to demonstrate this experimentally. Cymbale²⁸ naively suggests that a man with a unilateral chest wound would usually lie upon the unwounded side and the consequent immobilization of respiratory movements are the real cause in the production of contralateral collapse.

To recapitulate the explanation probably lies in more than one factor. First, to bronchial obstruction due to mucus plugs or foreign bodies or



Right

Left

FIG. 9.—Post operative massive collapse of right lung. Radiogram taken 11 days after that shown in Fig. 8 and 25 days after the taking of Fig. 5. Normal air inflation in right upper and lower lobes. Middle lobe not quite normal. Heart has returned to normal position. Right side of diaphragm normal. Radiogram taken by Dr. Henry Thissell, Germantown Hospital.

possibly to some paralysis or bronchial spasm due to a reflex irritation from other parts of the body. Secondly, to arrest of the respiratory muscles either of the chest walls or of the diaphragm itself, such arrest being caused by direct nervous influence but in a large proportion of cases by posture.

Progress.—In discussing the progress of the condition, resolution usually requires from ten to twenty-one days for return to normal. The patients at least those on record, practically never die from this condition unless it be bilateral massive collapse.

Complications.—It is the complications which produce the mortality. If

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inflammation supervenes, râles may appear and a friction sound be heard over the accompanying pleuritis. Expectoration rarely appears until pneumonitis is established, and it is rarely bloody until this stage is reached. Effusion has been known to occur. When the condition occurs as a complication of bronchitis, according to Norris and Landis,²⁰ or bronchial pneumonia, or whooping cough, it is usually attended by a blocking of the smaller bronchi. Its presence is inferred largely by an increase in the severity of the symptoms rather than by any other sign. Purulent bronchitis undoubtedly occurs as a complication, as is evidenced in our case. Pleurisy is not uncommon as a late complication. It is usually the dry variety giving rise to a friction rub, but effusion may occur later. Pneumonia, according to Rose-Bradford, is usually limited to the collapsed lobe.

Differential diagnosis must be made from acute dilatation of the heart, pulmonary embolus, pulmonary infarct, pleuritis, with or without effusion, and pneumothorax. If one bears in mind that the affected side is retracted and immobile, that the diaphragmatic and cardiac encroachment on the affected side is extreme, that the general symptoms are invariably less severe than with pneumonia, embolism and infarction, and the marked hyperresonance and increase of breath sounds with loud transmitted spoken voice sounds, the diagnosis should be made. To this should be added the high level of the diaphragm and the question of the displaced cardiac impulse. Such errors as subphrenic collection of gas and fluid have been made to account for the upward displacement of the heart and diaphragm on the side of the collapsed lung. Pneumothorax is also a frequent mistaken diagnosis. Cardiac dilatation has been an explanation of the misplaced cardiac area. The fact that even in cases of marked cardiac displacement the pulmonary physical signs may be comparatively slight, often gives rise to a mistaken diagnosis, such as dextrocardia, but after a lapse of a few hours or days there is usually a development of the pulmonary signs and, which is more conclusive, the return of the heart to its normal position. The upward displacement of the diaphragm is a sign of the greatest importance and it is detected on the left side by physical examination and on the right by X-ray. It should also be remembered that when the entire lung or the upper lobes are collapsed the displacement of the cardiac impulse is oblique. For diagnostic purposes Rose-Bradford divides the physical signs into three periods. In the first the signs are retraction and immobility of the affected side, together with the weakness or absence of breath sounds and displacement of the heart which is often extreme. In the second weakness of the breath sounds has been replaced by loud tubular or amphoric breathing together with increased vocal fremitus, loud bronchophony, pectoriloquy and transmitted spoken voice. In the third period, the stage when the lung is expanding, abundant râles may be present over the area where the tubular breathing is marked. In both the second and third stages the heart is still displaced, but as we have previously mentioned, the lung signs may sometimes persist over a small area, at a time when the heart has returned to its normal position.

Prognosis and Mortality It is impossible to estimate the mortality at the present time because of the general lack of recognition of the condition. We believe we have had two fatal cases during the last six months and obtained an autopsy in one.

Our purpose in presenting this subject before such a body is to obtain the real incidence of post-operative massive pulmonary collapse. We are convinced it is far greater than Pasteur's 6 per cent, which he reported in 1914. We offer the suggestion that collapse of the lung in varying degrees always follows any operative procedure, and any traumatic or inflammatory injury of the chest and trunk which may cause inhibition of normal respiratory movement by pain or posture. We also believe that it is a constant factor in all post-operative pulmonary complications.

CONCLUSIONS

We suggest that the phenomena of pulmonary collapse of varying degrees, together with pulmonary embolism and infarction, are the real etiological factors in post-operative pulmonary complications. That all other factors, such as anaesthesia, infection (either pre- or post-operative), preexisting lung disease, old age and debility, and the chilling of the body are contributory only.

We wish to express our obligations to the following contributors to this subject for the use of and many quotations from their writings.

Since the reading of this paper three more cases have been recognized and demonstrated by Röntgen.

REFERENCES

- ¹ Cutler. *Surgical Clinic of North America*, vol. 11, pp. 935, 945, Aug., 1922.
- Cutler and Hunt. *Arch. Intern. Med.*, vol. 111, pp. 449-481, April, 1922.
- ² Pepper. *Med. Clin. North Amer.*, 1921, vol. 1, pp. 737-749.
- ³ McKesson. *Amer. Jour. Surg.*, vol. 111, p. 16, 1918, *Quar. Sup. Anæsthesia*.
- ⁴ Norris. *Ill. Med. Jour.*, Oct., 1921.
- ⁵ Chevers. *Guy's Hospital Reports*, 1876.
- Mündl. *Deutsch. Zeit. f. Chir.*, July, 1921, p. 67.
- ⁶ Gottstein. *Klin. Arch. f. klin. Chir.*, vol. 111, p. 409, 1898.
- ⁷ Mikulicz. *Zerhandl. d. deutsch. Gesellsch. f. Chir.*, vol. 111, p. 560, 1901.
- ⁸ Henle. *Zerhandl. d. Deutsch. Gesellsch. f. Chir.*, vol. 111, p. 560, 1901.
- ⁹ Sauerbrock. *Zeitr. d. klin. Chir.*, vol. 111, p. 234, 1921.
- ¹⁰ Mündl. *Wien. klin. Wchschr.*, vol. 111, p. 214, May 5, 1921.
- ¹¹ Pasteur. *Amer. Jour. Med. Sciences*, 1890.
- ¹² Bibergeil. *Koertter's Clinic*, Berlin, 1906.
- ¹³ Rupp. *Arch. f. klin. Chir.*, Berlin, Mar. 21, 1921, vol. 111, p. 672.
- ¹⁴ Pasteur. *British Jour. Surgery*, 1914, vol. 1, p. 587.
- ¹⁵ Pasteur. *Middlesex Hospital Reports*, 1910, *Lancet*, London, 1910.
- ¹⁶ Briscoe. *Quarterly Jour. Med.*, 1919-1920.
- ¹⁷ Rose-Bradford. *Oxford Loose Leaf System Med.*, vol. 11, pp. 127-137.
- ¹⁸ Norris-Landis. *Diseases of Chest*, 1922, p. 487.
- ¹⁹ Tidy. *Lancet*, London, May 2, 1914, p. 1245.
- ²⁰ Grailley and Hewitt. *Reynolds System of Med.*, 1871, p. 865.

POST-OPERATIVE PULMONARY COMPLICATIONS

- ²³ Rose-Bradford Quarterly Jour Med, vol xii, 1918-19
- ²⁴ Schroeder-Green Amer Jour Med Sc, New Series 123, p 196
- ²⁵ Pearson-Irvine Clin Transact Lon, vol ix, 1876
- ²⁶ Lichtheim Arch Exper Path u Pharm, vol x, p 54
- ²⁷ Elliott-Dingley Lancet, London, May, 1914
- ²⁸ Cymble Brit Jour Surg, vol v, p 363, Jan, 1918
- ²⁹ Pasteur Bradshaw Lecture, London, 1908
- ³⁰ Scrimger Amer Jour Surg, vol xxxvi, pp 53-60, April, 1922
- ³¹ Herb J A M A, vol lxxiv, pp 339-342, July 29, 1922
- ³² Hirschbroeck Amer Jour Med Sc, vol clxiv, pp 268-274, Aug, 1922
- ³³ Scrimger Surg, Gyn and Obst, No 6, p 32
- ³⁴ Mortimer Medical Press and Circular, vol cviii, 1919, pp 507-09
- ³⁵ Schlotz Med Jour of South Africa, Jan, 1921, vol xvi, p 202
- ³⁶ St John
- ³⁷ Hampton and Wharton Johns Hop Med Bull, Apr, 1920, vol xxxi, p 95
- ³⁸ Hall Lancet, London, Jan 15, 1922
- ³⁹ Bailing and Levestre Manual of War Surgery, p 191
- ⁴⁰ Elwyn-Girsdansky J A M A, Aug 26, 1922, No 9, vol lxxiv

ANGINA PECTORIS AND SURGICAL CONDITIONS OF THE ABDOMEN

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THE differentiation of angina pectoris from surgical conditions of the abdomen is one of the most perplexing problems and one of the most dangerous pitfalls in diagnosis. The importance of a prompt and correct diagnosis is obvious, since surgical exploration in a patient suffering from angina pectoris is not only humiliating, but extremely hazardous.

Angina pectoris is a syndrome, not a disease, and may result from several disorders such as obliterative disease of the coronary arteries, aortitis, syphilitic and non-syphilitic, aortic valvulitis, aneurism, adhesive pericarditis, and occasionally stenosis of the mitral orifice. The pain invariably bears a definite relationship to influences increasing the load of the heart, as exertion, eating, emotionalism, and so forth. The pain is usually of the pressure or bursting type, varying from mild discomfort to agony, originating behind the sternum and radiating into the left arm. A sense of impending dissolution, an associated sense of constriction around the chest, and areas of hyperæsthesia often attend the severe seizures. Cases in which these typical symptoms are present do not offer diagnostic difficulties, but if the origin of the pain, the distribution and relationship are bizarre, much difficulty is experienced by both surgeon and internist. The fact that angina pectoris and many of the painful surgical conditions of the abdomen manifest themselves toward middle life adds more confusion to an already perplexing situation.

A few years ago I reported a group of cases of atypical angina pectoris in which the character, origin and distribution of pain, simulated practically every known surgical condition of the abdomen. The most common bizarre symptom was the sudden severe attack of pain, usually in the mid-epigastrium, or right upper abdomen radiating through to the back, usually precipitated by the ingestion of a heavy meal and associated with belching. I have recited the symptoms as I so frequently hear them from the patient, and certainly my first reaction to such a story is to believe that the gall-bladder is affected.

The importance of careful questioning and cross-questioning of patients in middle life should be strongly emphasized. In each case the possibility of angina pectoris must be considered. One should not rely too much on the patient's voluntary recitation of symptoms, as often important details are omitted and emphasis placed where it tends to mislead the questioner, as in the case of the patient who emphasizes the eating of a heavy meal, and does not mention the effect of exertion. Assuming that the patient is a man of sedentary habits who in his ordinary routine does not exert himself sufficiently to increase his cardiac load to the point of pain, the eating of an unusually

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heavy meal will always excite the attacks because the work required of the heart to digest this meal exceeds the threshold of his cardiac reserve

Another syndrome less frequently attending obliterative disease of the coronaries is that characterized by the sudden attacks of paroxysmal dyspnoea usually occurring at night or in the early morning, and not associated with exertion. Patients with these symptoms rarely complain of pain. Early writers referred to the condition as *angina pectoris sine dolore*.

It is an interesting fact that when *angina pectoris* of coronary origin occurs in women, it rarely assumes the serious aspects that it does in men. The seizures are usually not so severe, they may be present for a time then cease entirely and permanently. W. J. Mayo has repeatedly called attention to this fact. A woman does not ordinarily die in an anginal attack, although progressive heart failure often results in death. The reasons for this are not clear.

The coexistence of *angina pectoris* and surgical conditions of the abdomen is not uncommon. In this connection it may be noted that in eighty-six necropsies made at the Mayo Clinic in which sclerosis of the coronary arteries was found the gall-bladder was diseased in 24 per cent. When this coexistence occurs, the question of operation must be determined by the findings in the individual case. Certain internists, particularly the so-called cardiologists believe that a patient suffering from *angina pectoris* should not be operated on. Such an attitude I believe, is entirely unjustified, as in certain cases operation is indicated and distinct cardiac improvement is sometimes observed following operation, particularly, if an infectious process has been eliminated. W. J. Mayo has emphasized this relationship to infectious disease of the gall-bladder and biliary passages. If malignant disease is operable, I believe that surgery is always indicated, if the patient has a fair chance of surviving the operation. The patient should be carefully and completely examined, in order to obtain as much information as possible with regard to the cardiovascular system. Rontgenographic and electrocardiographic examination should be made when possible, and more important, the patient's reaction to increased demands on the heart and circulation should be cautiously determined. Needless to say, the facts regarding risk should always be frankly discussed, either with the patient himself or with his immediate relatives.

Pathologic Processes Causing Angina Pectoris Coronary Disease
Many American physicians have wholly or partially accepted Allbutt's emphatic statements, denying that obliterative disease of the coronary arteries is a cause of *angina pectoris*. However, one accustomed to seeing many patients with *angina pectoris*, and correlating clinical observations with necropsy findings, is quite unable to relinquish the coronary hypothesis. It is not my intention to invite a controversy, but I believe that in a great many instances, the coronary arteries are the cause of *angina pectoris*.

Considerable sclerosis of the coronary arteries may be present with relatively little impairment in the cardiac circulation, the obliterative type of arterial degeneration of either the larger or the terminal vessels being the cause of trouble. The obliterative process is one of atherosclerosis, a rather irregular thickening, having a tendency to encroach on the lumen of the vessel. The factors concerned with the production of arteriosclerosis are still hypothetical, but it is reasonable to believe that infections at least tend to cause such a process to advance more rapidly, and perhaps in some cases, initiate the damage. Evidence is accumulating, favoring the concept that arteriosclerosis follows severe infections, generalized arteriosclerosis in young patients at times has been observed to follow in the wake of the severe pandemics of influenza. Similar observations were made by physicians years ago, after the severe typhoid epidemics. It is reasonable to believe that a severe constitutional infectious disease may injure the arteries and that, in the reparative process, fibrosclerosis occurs. In view of this, the removal of possible infectious foci in the hope of delaying the progress of the degenerative process seems to be indicated, provided, of course, the damage has not been so extensive that death may result in a relatively short time.

The impairment in circulation may be only so slight, that no subjective discomfort is experienced by the moderately active patient in whom there are no detectable objective cardiac changes. It is only during the period of cardiac overload that the patient is aware of trouble. Since in middle life there is a very rich anastomotic coronary circulation, especially in the left ventricle the early obliterative changes may not cause alterations in the myocardium. A very clear idea of the coronary circulation may be obtained by studying the excellent photographs in Gross' book, which show the vascular changes as they occur through the decades.

As the obliterative changes progress, further trouble is experienced by the patient, the pain becomes more severe and the attacks occur more frequently and with less provocation. Owing to the progressive diminution in blood supply, degenerative myocardial changes occur, coincidentally with muscle weakness, and dilatation and hypertrophy. As the result of diminution of the blood supply, serious functional disturbances in the heart muscle may precede appreciable gross or histologic changes. While much is still unknown with regard to the intricate physiologic reactions of cardiac metabolism certain processes are evident. With the progressive narrowing of the coronary arteries the rate of blood flow through these vessels is undoubtedly retarded which tends to diminish the oxygen content, and to increase the carbon dioxide content of the venous blood. This status not only tends to favor fatigue of the heart muscle, but actually promotes degenerative changes.

There is much evidence in favor of the concept that the fundamental, characteristic property of the heart muscle, namely rhythmicity, which is an inherent quality, is the result of a physiochemic reaction which is alternately increased and diminished. With the advent of the string galvanometer, we

learned that electrical currents accompanying cardiac activity can be recorded and measured. The electropotential of the heart is probably the result of the fundamental reaction rather than its exciting agent. Quite early alterations in the physiology of the heart muscle are discerned by studying the changes in electropotential as recorded by the string galvanometer, thus much valuable information may be gained by the use of the electrocardiograph.

It is well known that patients suffering from angina pectoris of coronary origin present little or no evidence of cardiac disease. The roentgenogram is of little value in this condition as the heart is not enlarged, but often the electrocardiogram reveals changes of marked diagnostic and prognostic significance.

T-wave negativity, or inversion in certain isolated or combined derivations of the electrocardiogram, are the most important and common abnormalities. I have previously emphasized these findings, and have called attention to the high and early mortality among patients of whom these abnormalities are recorded. In order of importance T-wave negativity occurred (1) in combined Derivations I and II, (2) in Derivation I alone, (3) in combined Derivations I, II and III, and (4) in combined Derivations II and III. These findings, of course, are independent of the action of digitalis in producing T-wave negativity.

The graphic changes next in frequency and importance are the aberration of the QRS complex affecting all derivations. These changes likewise entail a high and early mortality. If the foregoing abnormalities coexist, the mortality is very high. Clinical methods do not suggest a clue to the presence of significant T-wave negativity, and therefore, the graphic findings are valuable and important diagnostic and prognostic adjuncts. Associated with aberration of the QRS complex in all derivations, however, frequently quite definite and characteristic auscultatory changes are detectable, consisting in a lack of definition and of differentiation in the heart tones, resulting in a tic tac rhythm almost fetal in character.

The presence of these graphic abnormalities should preclude surgical intervention except in those cases in which operation is imperative, as in operable malignant disease, strangulated hernia, acute visceral perforation, acute suppurative disease of the abdomen, or trauma from intra-abdominal hemorrhage. Whenever there is evidence of a failing myocardium, and surgery is not urgent, pre-operative cardiac preparation is indicated, the detail of which is, of course, an individual problem. Usually the heart should be well under the influence of digitalis, but the drug must be administered with caution and intelligence, as occasionally a patient suffering from coronary disease is observed in whom the painful seizures are exaggerated as the result of administering digitalis. The nitrites should be available during and after operation, and in my experience the most crucial time is when the patient first begins to be up and around. A local anæsthetic is always preferable, but ether well administered is not contra-indicated when the surgeon feels

that the operation can be performed with greater facility and speed with the patient asleep

Coronary Embolism and Thrombosis Many sudden deaths in middle and later life are due to sudden occlusion of the coronary circulation by embolism. An embolism of a small coronary artery is not always fatal, as in older persons there are rich anastomoses of the left ventricle. The size and location of the resulting infarct determine the seriousness of this accident. The characteristic syndrome attending coronary embolism is the extremely sudden onset of excruciating pain, usually behind the lower sternum or high in the mid-epigastrium, with variable and unreliable radiation. One of the most characteristic features of the pain is its persistence until death relieves the sufferer, or, when the infarct is small and has not involved a vital area until the heart begins to recover from the severe insult. The patient is in profound shock, with pallid cyanosis, cold perspiration, clammy extremities, rapid, shallow respirations later becoming the Cheyne-Stokes type, rapid, thready pulse, and the facies of extreme suffering. The blood-pressure is low. These symptoms are most often confused with the acute perforation of a gastric or a duodenal ulcer, the rupture of a distended gall-bladder, or acute hemorrhagic pancreatitis.

Physical examination, soon after the onset of the accident, may reveal only weak, rapid heart tones, the rhythm at times being interrupted by premature contractions and at times by respiratory arrhythmia. A few hours later a distinct pericardial rub is audible, usually to and fro in character, and heard best over the lower sternum. This rub is due to the inflammatory reaction of the visceral pericardium overlying the infarcted area. If the infarct is large, the area of cardiac dullness will be found to increase, owing to the weakening of the muscle with the development of an out-pouching or so-called cardiac aneurism. The upper abdomen may be distinctly resistant and almost rigid on palpation, falsely pointing to disease of the upper abdomen. This is in part, at least, due to the splinting of the diaphragm, a protective mechanism resulting from the patient's attempt to reduce the excruciating pain.

Leukocytosis, as high as 15,000 to 25,000 usually occurs, completely misleading to the uninitiated. Fever, often attaining from 100° to 102° may be present within twenty-four hours. The absence of pulsation in one or the other dorsalis pedis artery in cases of acute coronary obstruction is noted at times, but the reliability of this sign is doubtful. Electrocardiography is very helpful, giving a record virtually pathognomonic. The T-wave is markedly increased in amplitude and blends with the downstroke of R before its completion. In other words, there is a tendency of fusion between the R and the T-waves. Sudden high amplitude, and peaked inversions of the T-waves also occur especially if the patient recovers, and the infarction is presumably small. Pardee and Smith have reported instances of this type in the heart in both dog and man.

The importance of prompt and correct recognition of acute coronary

obstruction is evident since exploration, for an imaginary abdominal accident would invariably result in death

Syphilitic Aortitis It is not uncommon to disclose syphilitic aortitis in the course of a routine examination, although it is not often recognized early. In a recent study of 140 cases, only 7 per cent could be classified as early. In the present study anginal seizures occurred in 36 per cent of the cases, and in the majority the origin and radiation of pain were typical. Many of the bizarre cases closely simulated abdominal disease, and a number of the patients were referred with the diagnosis of gall-stones. There is very little difference between the character of the pain of syphilitic aortitis and the anginal pains of coronary disease, but in the former the pain tends to last longer and is very likely to radiate dorsally besides being distributed elsewhere. These slight variations are interesting, but have little quantitative value in the consideration of the individual case.

The diagnosis of syphilitic aortitis rests on an accurate history of infection and on the clinical symptoms, together with the accurate interpretation of physical findings, and the evaluation of special laboratory methods. Syphilitic aortitis is much more common in males than in females, the ratio being about 5 to 1. This, of course, is also true of syphilis in general, and supports Stokes' theory that there is an increased immunity in women against the ravages of the *Spinochaeta pallidum*. Another important point in the history of syphilitic aortitis is the long period from the manifestation of the primary lesion until subjective and objective symptoms of aortic involvement become evident. In our study this latent period was nineteen and one-half years.

In a recent publication I called attention to a physical sign very helpful in the recognition of early syphilitic aortitis. In order to appreciate the probable mechanics concerned in the production of this sign, a brief review of the pathology of the disease is necessary. The arch of the aorta is most often the seat of trouble, and next in frequency, the ascending aorta and descending aorta. Klotz has shown that the *Spinochaeta pallidum* gains entrance through the small lymphatics accompanying the vasa vasorum. The infectious process coming from without, first attacks the adventitia resulting in periaortitis. This explains the cohesion of the aorta to the surrounding structures, often observed at necropsy. The media and the intima then become involved, and the disease is well advanced.

Years ago Potain called attention to a peculiar tambour-like accentuation of the aortic second sound in certain patients with syphilis of the aorta. Later, Longcope and McCrae emphasized this observation, but evidently it has since been forgotten. Quite early in my experience with cardiovascular syphilis I was impressed with this unusual and distinctive aortic second tone, but did not fully appreciate its importance until the opportunity was afforded of observing a patient for several years. This patient had typical cutaneous syphilis, and was receiving rigorous treatment for syphilis at the time of the primary examination. The only finding was the peculiar tympanitic accen-

tuation of the aortic second tone The patient was again examined nine months later and this distinctive tone was absent, but a rough reverberant systolic murmur was heard at the aortic area, which was transmitted into the carotids At the end of eighteen months all the phenomena of a well-established aortic regurgitation were present I have since observed this sequence of events in five other cases

The probable mechanics of this distinctive aortic second tone is interesting and plausible in view of Klotz's work Recalling the fact that the primary involvement of the aorta is in the adventitia, it can readily be appreciated that the resulting periaortitis tends to diminish the elasticity or resilience of the aortic wall The inrush of blood from the heart with a competent aortic valve causes a sudden and sharp closure resulting in the phenomenon described A rather rough reverberant systolic murmur at the aortic area, often transmitted into the carotids, is probably indicative of intimal involvement, and is evidence of a moderately advanced aortic syphilis With the appearance of the systolic murmur, the tympanic second tone usually disappears, and at this stage there is usually a variable degree of hypertrophy of the left ventricle

The syphilitic process is retrogressive as well as progressive and eventually the aortic valve leaflets or ring become involved with the development of aortic regurgitation The signs of aortic regurgitation are too well known to need comment, it is an indication of advanced aortic syphilis The syphilitic process is associated with a marked tendency to reparative fibrosis which is responsible for much of the progressive myocardial damage Fibrotic changes of the aorta in the vicinity of the coronary orifices may advance until there is almost complete closure of the orifices The effect on the heart, as the result of the narrowing of the orifices is identical with that of obliterative disease of the coronaries themselves The patients almost always have severe anginal attacks or seizures of paroxysmal dyspnoea Usually the heart is considerably dilated particularly the left ventricle, and out of proportion to the attendant hypertrophy

In many cases the electrocardiographic findings are identical with those frequently observed in cases of obliterative coronary disease, that is, significant T-wave negativity and aberration of the QRS complex in all derivations In the early and the moderately advanced stages of aortic syphilis the graphic records reveal very little of importance

Non-syphilitic Aortitis—The most common non-syphilitic affection of the aorta is atherosclerosis It is, in reality, a degenerative rather than a true inflammatory process, occurring in the course of the progressive, more or less generalized arteriosclerosis of advancing years, but at times is dominantly manifested It is a frequent accompaniment of the arterial degeneration of the cardiovascular-renal syndrome with hypertension Next in frequency is the aortitis due to rheumatic fever, practically always associated with and often secondary to, endocarditis of the aortic valves Typhoid fever, influenza and many of the exanthematous fevers have been ascribed as causes

of aortitis, but they probably are rather infrequent causes. Anginal attacks occur much less frequently with the non-syphilitic forms of aortitis. The usual physical sign of the disorder is a systolic aortic murmur having a greater range of transmission, being at times distinctly audible well over the lower sternum. It is, as a rule, more prolonged than the murmur in cases of syphilitic aortitis, and is harsh, but does not possess the reverberant character of the former. The aortic second tone is usually accentuated except when the aortic valves are incompetent. When hypertension is present, the aortic second tone is very distinctly accentuated, and often has a distinctly metallic quality. The heart is enlarged, and hypertrophy of the left ventricle dominates until failure results, when dilatation progresses disproportionately. Significant T-wave negativity is often revealed by electrocardiographic examination.

Aneurism Syphilis is the cause of aneurism in most instances. The condition is often associated with angina pectoris. The thoracic aorta is usually the seat of aneurism, the arch and ascending portion most often, and the descending portion least often. The pain of aneurism usually is like that in the typical descriptions of angina pectoris, except that it usually is boring in character, tends to be more persistent, is likely to occur independent of cardiovascular overload, and often the dominant radiation is dorsal.

The physical signs of thoracic aneurism are too well known to enumerate them here. There is no excuse to fail to recognize an aneurism after careful examination except when it has very unusual features. I distinctly recall a case of large aneurism of the descending aorta that simulated, both in physical signs and in the roentgenogram, a large effusion of the left chest.

Aneurism of the abdominal aorta is rare, it produces pain often simulating that in surgical conditions of the abdomen. The aneurism almost always occurs in the immediate vicinity of the celiac axis. Aneurism of the abdominal aorta is usually mycotic, the result of a weakening of the wall at a point of bifurcation, due to pyæmic embolism. Syphilis is the next most common etiologic factor, while trauma plays a lesser rôle. Besides having pain, the patient is made uncomfortable by the epigastric pulsations, which often overshadow the pain. The aneurisms are usually fusiform or diffuse, sacular dilatations of the abdominal aorta are less common. Early recognition of abdominal aneurism is difficult and uncertain, and diagnosis is not possible until the pulsating tumor is palpable in the epigastrium. A distinct systolic bruit or thud is often audible over the tumor. Not infrequently the pulsations of the abdominal aorta of an undernourished, nervous patient, or the increased pulsations of the aorta of a patient with hyperthyroidism, are mistaken for aneurism although there is no occasion for this error. The X-ray does not aid in the recognition of abdominal aneurism. It is needless to say that operative intervention, if the aneurism is large, is contra-indicated unless absolutely urgent.

Adhesive Pericarditis Adhesive pericarditis, particularly if there is

cohesion of the pericardium near the base of the heart with the mediastinal structures, is often the cause of anginal pain usually in the chest, but occasionally it is entirely in the upper abdomen. The pain may bear a definite relationship to cardiac overload. Adhesive pericarditis results from inflammatory thoracic disease such as left-sided pneumonia, pleuritis, mediastinitis, empyema and so forth. Primary extensive fibrinous or suppurative pericarditis besides causing adhesions between the two layers of the pericardium, may cause the sac to be bound to the mediastinal structures, or to the pleura. Influenza has been a relatively common cause of mediastinopericarditis. The diagnosis of the condition, as a rule, is not difficult. It should be borne in mind constantly during routine examination of the chest, which usually reveals the salient diagnostic signs. A careful scrutiny of the apex beat discloses a definite retraction of the intercostal structures during each systole of the heart. There are usually similar retractions posteriorly in the ninth to the twelfth intercostal spaces, the so-called sign of Broadbent. In marked cases the whole lower left thorax will be seen to be drawn in with each cardiac systole. The heart dulness is practically always increased, varying with the degree of associated myocardial disease. Over the lower sternum, and at times over the middle and upper sternum a distinct pericardial rub is audible. With the patient leaning toward I have repeatedly observed a rub which otherwise was undetectable.

The false retractions of an enormously dilated heart must not be confused with the retractions of an adherent pericardium.

Vitral Stenosis—Chronic endocarditis of the mitral valve with stenosis produces anginal attacks so infrequently that only its mention is warranted. In the cases I have observed the pain was limited to the chest.

BIBLIOGRAPHY

- ¹ Allbutt Sir Clifford Diseases of the Arteries Including Angina Pectoris London, Macmillan 1915 vol II
- Gross L The Blood Supply of the Heart New York, Hoeber, 1921
- ² Klotz, O Some Points Respecting the Localization of Syphilis upon the Aorta Am Jour Med Sc, 1918 vol clv, pp 92-100
- ³ Mayo W J Certain Medical and Surgical Aspects of Disease of the Biliary Apparatus Ill Med Jour, vol xlv, pp 33-37
- Mayo W J Personal Communication
- ⁴ Pardee H E B An Electrocardiographic Sign of Coronary Artery Obstruction Arch Int Med 1920 vol xxxi pp 251-258
- Smith F M Electrocardiographic Changes Following Occlusion of the Left Coronary Artery Arch Int Med 1923 vol xxxiii pp 496-510
- ⁵ Willius F A Atypical Pain with Angina Pectoris Med Clin N Amer 1921 vol v pp 371-393
- ⁶ Willius F A Electrocardiography and Prognosis Arch Int Med 1922 vol xxx, pp 434-450
- Willius F A and Barnes A R Syphilitic Aortitis Minn Med (In press)

NON-CALCULOUS INTERMITTENT BILIARY OBSTRUCTION FOLLOWING CHOLECYSTECTOMY

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REMOVAL of the gall-bladder on the basis of the symptoms and clinical history in the absence of a local lesion, invites discredit on the judgment of the surgeon and the operation. Sad experience has shown that gastro-enterostomy does not relieve symptoms of peptic ulcer if there is no ulcer. On the other hand, an attempt to remove the gall-bladder from a very sick patient, if severe infection, deep jaundice or other well-recognized contraindications exist is hazardous, and the risk unnecessary. Under these conditions, a palliative drainage operation with minimal interference is the procedure of choice. Cholecystostomy will continue to hold a prominent place in biliary surgery and will cure many patients, but cholecystectomy, when it can be safely performed, will do the most good to the greatest number. The diagnosis of cholecystitis in the absence of stones is often difficult, even when the gall-bladder is visible. The presence of adhesions and enlarged regional lymph-glands, and the appearance of the liver will often help confirm an otherwise doubtful diagnosis. It is generally believed that the gall-bladder has a function, and should not be needlessly sacrificed, even though an individual can live comfortably without it. The diseased gall-bladder loses its function, which with the fact that more than 50 per cent of the patients whose gall-bladders have been drained have had recurrence of symptoms requiring a second operation, seems to indicate that the best procedure is removal of the organ in the presence of local disease. Granted that removal of the gall-bladder is justified, the surgeon will still be called on to treat a small group of patients with persistent or recurrent symptoms. A definite percentage of these will have stones in the common duct which probably were present at the time of the former operation.

The mimicry of upper abdominal diseases by an inflamed appendix, and its frequent association with infection in the gall-bladder, make its removal almost a routine procedure in operations on the biliary passages. Injury to the ducts at operation, if not recognized and repaired at once, will surely demand later interference of a very formidable nature. Of forty-seven cases of stricture of the common duct which we recently reviewed more than half were located at the juncture of the cystic duct where the gall-bladder had been removed and may have been the result of injury. Careful technic and thorough exposure should prevent such injury.

We believe that the most potent cause of persistence of symptoms after cholecystectomy is delay of the patient in coming to operation. Patients are often seen who have had definite symptoms of biliary disease for ten or fifteen years, many having suffered irreparable damage to the liver and pancreas. It is misguided optimism, however, to expect that removal of the gall-bladder, although diseased and full of stones, will always relieve such patients of their symptoms.

It is becoming more generally recognized, chiefly through the work of Graham, that the liver, pancreas and appendix are commonly infected with the gall-bladder. Persistence of infection in these organs is often a cause for recurrence of symptoms after cholecystectomy. Such symptoms may continue for several months after operation and then disappear, but in a certain number ultimate cure does not result, and at the second operation the meagre findings do not explain the patient's symptoms. Having seen a number of such patients relieved by drainage of the common duct, we selected from the records of the Mayo Clinic for detailed study a series of twenty-four cases from a large number in which secondary operations had been performed on the biliary tract. No cases of stones in the ducts, stricture, biliary fistula, or other gross lesions, were selected.

Seven of the twenty-four patients were men and seventeen women. The youngest was twenty years and the oldest sixty-nine, the average age being forty-five years.

Symptoms Occurring Before the Primary Operation on the Gall-bladder—The longest duration of symptoms was fifteen years and the shortest, three months, the average being forty-three and one-half months. Typically severe hepatic colic was associated in twenty-two cases, jaundice in ten, fever in four, upper abdominal pain not colicky in one, and reflex gastric symptoms in one. The foregoing symptoms correspond with the history usually elicited from patients suffering from disease of the gall-bladder. Attention is directed to the fact that the average duration of symptoms was more than three and one-half years. Probably no other obviously surgical condition is allowed to progress so long.

Primary Operation—The primary operation was performed in the Clinic in nine cases and elsewhere in fifteen. Detailed information was available regarding the lesions in the nine cases, while in the group of fifteen, data were obtained from patients, based on the information given them by their surgeons. In several instances the patients had letters describing the findings at the original operation.

The gall-bladder was diseased in every case, in fifteen it contained stones, and in nine there was cholecystitis without stones. Stones were found in the common duct in two cases. Pancreatitis was noted in four, and appendicitis in eight. These lesions represent about the usual findings in a group of cases of gall-bladder disease. Primary cholecystectomy was performed in nineteen cases, the appendix was removed in sixteen, at the time of the opera-

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tion on the gall-bladder in eight, and at some time preceding the operation on the gall-bladder in eight. Cholecystostomy followed by cholecystectomy was performed in five cases. The common duct was opened and a stone removed in one of these.

Symptoms after Cholecystectomy The time of onset of the post-operative symptoms varied from a few weeks to four and one-half years. Recently we saw a patient, not included in this series, who had a recurrence of symptoms seven years after cholecystectomy, but at the second operation there was little evidence of disease. In nine cases the symptoms appeared during convalescence and continued intermittently until the second operation. In the remaining fifteen the average time of onset was two months after operation. Severe colicky pain occurring in attacks similar to those preceding the original operation was the cardinal symptom in all cases, and was the chief reason for seeking relief by a second operation. Two patients had chills and fever with the attacks, thirteen had jaundice following the attacks of colic, six of whom noted clay-colored stools. We believe these symptoms were caused primarily by temporary biliary obstruction, although only slightly more than 50 per cent of the patients had jaundice. It has been shown experimentally in the dog that the common duct must be completely obstructed for at least twelve hours in order to cause jaundice. It is probable that there may be blockage of the common duct in man, long enough to cause the severe pain of sudden obstruction, which may be relieved before jaundice has had time to develop. The duration of symptoms before the second operation varied from three weeks to seven years, the average being twelve and seven-tenths months.

When these patients were examined in the Clinic, the symptoms and clinical history seemed to warrant the diagnosis of stone in the common duct. The majority of patients who have severe colic following cholecystectomy, with associated chills, fever, and intermittent jaundice, will be found to be suffering from stone in the common duct. In twenty-three of our twenty-four patients such a diagnosis was made. Pancreatitis was diagnosed in one case, one patient had evidence of biliary cirrhosis.

Second Operation The common duct was opened and explored. In twenty-two cases a Robson drain was inserted into the common duct. In two cases the duct was closed tightly by suture after the exploration, but there was drainage of bile for several weeks. The appendix was removed in five cases. The stump of the cystic duct was excised in two. In cases in which the common duct was drained the bile continued to discharge through the tube or fistulous tract for from three to four weeks. One patient died in the hospital from hemorrhage, cholangitis and biliary cirrhosis.

Findings at Second Operation The most constant lesion was pancreatitis, not the hard interstitial type, but resembling that termed by Deaver pancreatic lymphangitis, it was present in seventeen cases. The degree of involvement of the gland was one in four cases, two in seven cases, three in

five cases, and four in one case. The changes in the pancreas were determined by palpation, and in a few instances by inspection of the gland. It is fully appreciated that this method of diagnosis is subject to considerable error, because of the personal equation of the surgeon. Nevertheless it is recognized that advanced pancreatitis, and the type of gland resembling malignancy can always be detected by the experienced surgeon. In none of these cases was the pancreas sufficiently affected to suggest malignant disease. Regardless of the degree of involvement there was no biliary obstruction at the time of the operation, nor was there any form of intraductal obstruction such as stone, because in every case the common duct was opened and probes and scopes were passed freely into the duodenum. Evidence of cholangitis was present in three cases, and of hepatitis in most of the cases. Enlargement of the regional lymph-glands was found in two cases. The liver was definitely enlarged in three cases and the spleen in two. The common duct was dilated beyond normal size in all. In two cases there was a small granulating mass in the stump of the cystic duct. A diseased appendix was found in five cases. Adhesions of the usual kind following operations on the gall-bladder were present in eighteen cases but they were not causing obstruction of the ducts and were not considered responsible for any of the major symptoms. Two negative explorations were performed, that is, no actual lesions were found, although drainage of the common duct was established for empiric reasons.

Questionnaires were sent to all patients in an endeavor to learn their present state of health and whether they had had a return of symptoms. We were able to obtain information concerning the ultimate result in twenty-two of the twenty-four cases. Three patients are dead. One died from unknown causes after leaving the hospital, and one died two years after operation from "general collapse," but had been completely relieved of the symptoms for which the operation was performed. Three patients still complain of their former symptoms, one has biliary cirrhosis, one has severe attacks of pain associated with clay-colored stools, and the other, while still having pain and discomfort in the epigastrium, does not have the severe colics that he had before operation. Sixteen patients have been entirely relieved of their symptoms. Most of them obtained relief in from four to six weeks after operation. One continued to have symptoms for one year and another for four years but both are now in good health.

Discussion—We believe that these results justify the course of surgical treatment which was carried out in this group of patients. As usual, empiricism has led the way and it remains for theory and experimentation to establish the correct explanation.

There seems to be little doubt that intermittent biliary obstruction was the main cause of symptoms. Stone in the common duct was suspected, but not found at operation. Of course a stone may have passed, but there was no evidence of it and the common duct was normal except for dilatation and it contained normal bile. There was no other form of intraductal obstruction.

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as in every instance the ducts were carefully explored and found to be free. We believe that the explanation lies in the persistence or recurrence of infection in the liver and pancreas, and in a few instances, in the appendix. The theory of infection is further borne out by the fact that the majority of patients were relieved by prolonged drainage of bile to the outside. A considerable number of patients with cholecystitis have involvement of the pancreas, and usually the pancreatitis will subside following removal of the gall-bladder.

It is well known that disease of the pancreas such as cancer of the pancreas, and the hard interstitial type of pancreatitis, can give rise to obstruction of the common duct and jaundice. It represents more or less permanent biliary obstruction, characterized by jaundice, slow and painless in onset, but constant and progressive. It is not generally recognized that the pancreas can be responsible for intermittent biliary obstruction, but we believe that the cases herein reported are examples of this condition. A number of years ago, Morison called attention to the analogy between the biliary and urinary systems. Gradual obstruction results in painless dilatation of the proximal ducts, while sudden complete obstruction causes rapid distention and pain. In this analogy, the pancreas, from a mechanical and anatomic standpoint, may be likened to the prostate. Intermittent obstruction at the outlet of the bladder can be caused by infection in the prostate, while obstruction, more or less permanent in character, results from hypertrophy or malignancy. The swollen, oedematous gland of pancreatic lymphangitis, the type associated with cholecystitis, might in a similar manner, cause intermittent biliary obstruction, colic, and even jaundice. The normal gall-bladder functions as a tension bulb in the presence of common duct obstruction as in cases of carcinoma of the pancreas. After removal of the gall-bladder any sudden obstruction to the common duct causes rapid distention of the proximal ducts with resulting pain. If the elasticity of the gall-bladder has been destroyed by disease, or if it has been removed, pancreatitis may be the cause of biliary obstruction, severe colic and jaundice. This is probably the explanation of events in some cases of cholecystitis without stones, in which severe colic and jaundice have occurred.

After reviewing the histories of these patients, we are convinced that an accurate diagnosis cannot always be made. The symptoms are those of intermittent biliary obstruction, the usual cause of which is stone in the common duct. The surgeon should not be disappointed if he occasionally fails to find a stone. Drainage of the ducts will relieve the symptoms in most cases.

ACUTE APPENDICITIS IN CHILDHOOD

A STUDY OF 145 CASES OBSERVED AT BELLEVUE HOSPITAL
OF NEW YORK CITY

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THE 145 cases of acute appendicitis analyzed in this paper constitute a series of consecutive cases operated upon on the Children's Surgical Service of the Fourth Surgical Division, Bellevue Hospital. They include children of ages up to thirteen years. These patients were treated in the hospital from December, 1919, to January, 1923, inclusive, a period a little longer than three years. After discharge from the hospital they were kept in touch with by means of our "Return Clinic." We have been able in this way to see personally the late results of 126 out of 134 of our living cases, a percentage of 94.02. In addition, one case was seen by our social worker and one we heard from by letter, six we were unable to trace.

In all statistics of final results our figures are based entirely upon the 126 cases which we have been able to see personally. On none was the final examination made at a period less than six months after discharge from the hospital and in some the period between discharge from the hospital and final examination was as long as three years.

To include a case as one of acute appendicitis, the records had to state definitely that there were gross pathological lesions of acute inflammation present.

The procedure as carried out in these cases was as follows. As soon as a diagnosis was made the patient was operated upon, the usual incision being the right rectus, with separation of the muscle fibres. In all there were 113 cases in which this incision was used, the McBurney gridiron incision being employed only thirty-two times. An analysis of incidence of incisional hernia in relation to these two types of incision could not be made as the McBurney incision was seldom used in the more severe cases. The reason for using the right rectus incision so often in children is that we feel it gives a very much better exposure, permits easier exploration, and is more flexible for adaption to new conditions when a mistake has been made in diagnosis. The McBurney is most useful where it is known that there is an abscess immediately below the position of the incision. The appendix was removed by means of the cautery, the stump being inverted into the cæcum by means of a purse-string stitch of linen thread and reinforced with a few peritoneal stitches of number 0 chromic. In a few cases the appendix was merely ligated as the caecal wall was too indurated to allow inversion.

Drainage of the peritoneal cavity was used in all cases in which the appendix had perforated and also in those in which marked induration of the tissues surrounding the appendix was present. In abscess cases, a single

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drain in the cavity was usually sufficient, but in the cases of spreading peritonitis a drain was usually placed in the pelvis as well as in the right lumbar gutter. The ordinary cigarette drain—a wick of gauze surrounded by rubber dam—was used, the abdominal wall being closed in layers about it. Following operation, fluids were pushed usually by means of enteroclysis (tap water with 5 per cent glucose and 5 per cent soda bicarb) or in the very sick hypodermoclysis was resorted to. No post-operative catharsis was used, for we found that enemas were quite sufficient to control distention, in the more severe cases we have used stupes.

Blood transfusion by the whole blood method was found to be very beneficial in the long-drawn out cases of sepsis.

The cases have been classified into three groups. Those that had not perforated, those that had perforated and in which there was free purulent exudate in the peritoneal cavity, a spreading peritonitis, and those of perforation in which the exudate had been localized by adhesions and formed an abscess.

The incidence of acute appendicitis among children is of interest from the standpoint of age. In the first 5 years of life we had 17 cases, or 11.7 per cent of our series, from the 5th year to the 13th there were 128 cases, a percentage of 88.3, the greatest number of cases, 30, or 20.7 per cent of the whole, were found to be of the age of 11, our youngest case was 20 months, the average age was 9 years, the number of cases for each age increased up to 11, where it seemed to reach its maximum. This is shown very well in the accompanying table.

TABLE I

Age	Male	Female	Total	% of series
1	1	0	1	7
2	4	1	5	3.5
3	2	2	4	2.8
4	4	3	7	4.8
5	3	1	4	2.8
6	7	6	13	8.9
7	6	4	10	6.8
8	10	8	18	12.4
9	13	6	19	13.2
10	14	6	20	13.9
11	19	11	30	20.6
12	8	6	14	9.6
Total	91	54	145	100

FENWICK BEEKMAN

There was a very decided difference in the two sexes, 91 males (62.8 per cent) compared with 54 females.

In our 145 cases we had 11 deaths, a mortality of 7.58 per cent. The accompanying table shows the age and immediate cause of death.

TABLE II

Age	Sex	Time sick before operation	Additional diagnosis	Time between operation and death	Apparent cause of death
20 mos	M	3 days	Spreading peritonitis	Less than 24 hours	Toxæmia
2 yrs	F	4 days	Spreading peritonitis	Died on table	Toxæmia
2½ yrs	M	3 days	Spreading peritonitis	Less than 24 hours	Toxæmia
2½ yrs	M	6 days	Abscess	27 days	Fecal fistula Secondary abscesses
2½ yrs	M	2 days	Spreading peritonitis	Immediately after operation	Toxæmia
3 yrs	F	3 days	Abscess	3 hrs after operation suddenly	Status lymphaticus (autopsy)
5 yrs	F	2 days	Spreading peritonitis	Less than 48 hours	Toxæmia
9 yrs	M	12 days	Abscess retrocæcal	Less than 24 hours	Shock
10 yrs	F	2 days	Spreading peritonitis	7 days	Sepsis (convulsions)
10 yrs	F	2 days	Spreading peritonitis	Less than 24 hours	Toxæmia
11 yrs	F	3 days	Spreading peritonitis	Less than 48 hours	Toxæmia

5 males 610 males
8 deaths from spreading peritonitis 72 per cent
Average age at death 5.33 years
Time sick before operation 3.4 days

In the first five years of life there were 17 cases with 6 deaths a mortality of 35 per cent. In the second half of this decade (that is from the 5th through the 10th year) there were 64 cases with two deaths a mortality of 3.1 per cent. The mortality for the first decade (from birth to 10 years) was 9.8 per cent. From the beginning of the 5th to the 13th year there were 128 cases with 5 deaths a mortality of 3.9 per cent. It is to be noted that the highest mortality was in children under 5 years of age. The mortality rate of the girls was just twice that of the boys (female 11.1 per cent male 5.5 per cent).

Eight deaths occurred in patients with spreading peritonitis and 3 with abscesses. There was no mortality among the cases in which perforation

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had not taken place. The average age of children who died was 5.3 years. the average time sick before operation was 3.4 days.

There were 41 cases of spreading peritonitis and 53 with abscesses, leaving 48 in which the appendix had not perforated, and of these 48 cases 40 were not drained. Thus the appendix had perforated in 97 patients, 67 per cent, or two-thirds of the admissions. All cases (21) under the age of 6 years had perforated, 14 having spreading peritonitis and 7 abscesses. After this age there was no appreciable difference from year to year. The mortality for perforated cases was 11.3 per cent.

TABLE III
Time Between Onset of Symptoms and Operation

		No. of cases	Per cent	No. of days preceding operation
Unperforated	Not drained	40	27.6	1.7
	Drained	8	5.6	1.9
		48	33.1	1.7
Perforated	Spreading peritonitis	44	30.4	2.5
	Abscess	53	36.4	4.5
		97	66.9	3.6
Total cases		145	100	3

Spreading Peritonitis—Of the cases with spreading peritonitis the period between onset of the disease and operation was an average of 2.5 days. The longest was 8 days, but this was apparently a case in which an abscess had ruptured, the shortest period was 14 hours. Of the peritonitis cases 8 died, 18.2 per cent, and these patients accounted for 7.2 per cent of all deaths. There were 11 cases whose convalescence was complicated, 2 had pneumonia, 7 had secondary abscesses, in one the wound burst open on the 8th day, and one had chronic sepsis, it being the only death among these cases with complications. Of the remaining 7 deaths, 1 died on the table, 4 died a few hours after operation, and 2 lived for at least 48 hours after operation, death in three being due to toxæmia.

Abscesses—Of the 53 cases with perforation and abscess formation the operation was performed on an average of 4.5 days after the onset of the disease, the longest time being two weeks and the shortest 36 hours. The remainder of the total deaths, three in all, had abscess (5.7 per cent mortality for the group). One of the cases died of status lymphaticus a few hours after operation, the second died apparently from shock, and the third died from sepsis at the end of 4 weeks. In one case the patient had been operated upon two years previously at another hospital for an appendicular abscess, but the appendix had not been removed, and in another we did not remove the appendix, as it was too adherent to the wall of an abscess. There were 2 cases of post-operative pneumonia, one being complicated with a

suppurative pleurisy and facial erysipelas. There were 7 cases which had secondary abscesses, of which 2 developed fecal fistulas, another with multiple abscess developed empyema.

Unperforated Cases There were 8 cases in which no perforation of the appendix occurred, though the abdomen was drained. In this group the average period between onset of the symptoms and operation was 19 days, there were no deaths. One case developed multiple secondary abscesses, and another an osteomyelitis of the right femur.

There were 40 cases in which the peritoneal cavity was not drained, in one of which the abdominal wall was drained. The average period before operation in these was 17 days. There were no deaths nor complications except for two infections of the abdominal wall.

Complications—There were 15 cases which had secondary abscesses, 10.3 per cent. Of these 11 were located between coils of intestines, 1 was subdiaphragmatic and 3 were in the region of the right kidney. One of the cases, which had an abscess in the kidney region, also had a pelvic abscess, 7 of these abscesses followed spreading peritonitis, 7 followed perforation of the appendix with abscess and 1 developed in a case which had not perforated but was drained. The subdiaphragmatic abscess followed a retro-cæcal appendix with abscess.

Infection of Abdominal Wall Two cases had infections of the abdominal wall, both of which had been closed without drainage.

Post-operative Pneumonia There were 4 cases (2.7 per cent) which developed pneumonia after operation, 2 of the right lung and 2 of the left.

Empyema—Of the 2 cases (1.4 per cent) of empyema, both upon the right side, one followed a post-operative pneumonia and the other was an extension from a subdiaphragmatic abscess.

Fecal Fistulas There were 2 cases (1.4 per cent) of fecal fistulas, both in cases complicated with abscesses. One of these died upon the 28th day after operation.

In addition there was 1 case of facial erysipelas, following a post-operative pneumonia, and a case which developed an osteomyelitis of the upper end of the right femur about four months after discharge from the hospital, that this had anything to do with his appendicitis is doubtful.

Hernia—There were 16 cases of incisional hernia, a percentage of 12.7 for all and 18 for those that were drained. In addition there were 3 recent cases in which the note on the chart showed that there was relaxation of the muscles but no real sac. These are not included among the hernias, as 8 other cases, with relaxed musculature noted some three or four months after discharge later developed a strong abdominal wall without further treatment. There was no difference in predisposition to hernia in either sex. Incidence to age showed a gradual decrease in the frequency of this sequelæ as age advanced.

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TABLE IV

Relation of Age to Occurrence of Incisional Hernia

Age	No of cases followed in series	No of hernias	Percentage
2	1	0	0
3	3	0	0
4	5	0	0
5	2	2	100
6	12	1	8.3
7	9	4	44.4
8	18	2	11.1
9	16	3	18.9
10	18	2	11.1
11	29	2	6.8
12	13	0	0
Total	126	16	12.7

Eleven of the hernias have since been operated upon and apparently cured. All hernias developed in cases that had been drained, 8 followed spreading peritonitis, 7 abscesses, and 1 was a sequel to operation upon an unperforated appendix that was drained.

A special study was made of the records of these cases.

Of the 16 cases, which developed hernia, in 12, portions of the abdominal wall about the wound sloughed to a greater or lesser extent. In 6, secondary abscesses developed which had to be drained, either through the original wound or through a counter incision. In 3, the edges of the wound separated. In 1, a fecal fistula developed, and in 2 cases, there was an actual prolapse of a coil of intestines through the wound. Additional causes were severe distention with continuous vomiting in 6 cases, and in all there was more or less loss of muscular tone, because of their long drawn-out convalescence, the temperature being raised on an average of 20 days for all cases.

In Case 80 no reason could be found for the later development of hernia, but as this patient had a rise of temperature for 15 days following the operation there must have been some condition present which was not recorded. Where the hernia was small, its location was in the portion of the scar through which the drain had passed. The average stay in the hospital of these cases which later developed hernias was 34.7 days.

The accompanying table tabulates the possible cause of hernia amongst these cases.

TABLE V

Case No	Sloughing of abdominal wall about wound	Secondary abscess	Separation of wound edges	Fecal fistula	Evisceration of loop of intestines	Distention and straining	No apparent cause
19	+	+				+	
21	+					+	
23	+						
33	+						
40	+	+					
46		+					
63	+	+	+	+	+		
80							+
85	+						
90	+						
93	+	+				+	
95	+					+	
114			+				
129	+	+					
133	+					+	
139			+		+	+	

There were 6 cases which developed large keloids in their scars, 4 of these had been drained and the remaining two healed by primary union

Symptomatology—The onset of the symptoms was usually sudden, with severe general colicky pain, which later became localized and constant Vomiting was an almost invariable symptom where it had not taken place early in the disease, we found that it almost always followed the giving of a cathartic which was so often prescribed before the patient was admitted Of the non-perforating cases 41, or 85 per cent, had vomiting as a symptom, and 2 of the remaining 7 were nauseated, of the 44 cases of spreading peritonitis 43 or 97.7 per cent vomited, the remaining patients being nauseated and of the cases complicated with abscess 44 or 83 per cent, vomited 2 of the remaining 9 being nauseated

The temperature was always raised, the elevation apparently depending upon the amount of tissue involved by the inflammation In the cases that had not perforated the mean temperature was 101.3°, the highest temperature recorded in this group being 104° and the lowest 99° There were 8 cases in this group of 48 with a temperature between 99° and 100° In the spreading peritonitis group, the mean temperature was 102.1° and the two extremes were 105° and 99°, the latter being the only one under 100° In the abscess cases the mean was 101.5°, the maximum 104° and the minimum

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99.6° There were only two cases with temperature under 100° among the abscess cases

TABLE VI
Temperature, Pulse and Respiration

Diagnosis	Mean temperature	Mean pulse	Mean respiration	Relation of respiration to pulse rate
Unperforated cases	101.3	113	25	4.5
Spreading peritonitis	102.1	127	32	4
Abscess	101.5	116	28	4.1

The pulse and respiratory rates were increased in almost all cases. They were lowest in the unperforated cases, the mean being, pulse 113, respiration 25, and highest in the spreading peritonitis group, pulse 127, respiration 32, while the abscess cases had a mean pulse rate of 116 and respiratory rate of 28. The ratio of respiratory rate to pulse was in inverse order to the above, spreading peritonitis 4, abscess 4.1 and unperforated 4.5.

The 48 cases in which the appendix had not perforated, all except 6 had well-localized tenderness but no rigidity, and in only 1 was the tenderness and rigidity general. In the cases complicated with spreading peritonitis, tenderness and rigidity were general over the abdomen, except in 10 cases where these signs were confined to the right side. In the cases accompanied by abscesses the signs were localized over the site of the disease in all but 9 cases, of these latter, the tenderness and rigidity was general in 8 and in 1 case there was no rigidity. It was stated in the histories that a mass was felt by abdominal palpation, in 18 (34 per cent) cases of abscesses and 2 (4.5 per cent) of spreading peritonitis, where rectal masses were felt, 1 was in a case of spreading peritonitis and 3 had abscesses.

TABLE VII
Abdominal Signs

Diagnosis	No. of cases	Tenderness		Rigidity		Mass present	
		Local	General	Local	General	Abdominal	Rectal
Unperforated cases	48	47	1	43	1	0	0
Spreading peritonitis	44	10	34	9	35	2	1
Abscess	53	45	8	44	8	18	3
All cases	145	102	43	96	44	20	4

The leucocyte and differential counts were variable, high counts (30,000) and high percentages of polymorphonuclear leucocytes (94 per cent) were found in cases of all three groups. There were no normal counts. It can be said that both counts appeared to rise proportionally in the following order: cases that had not perforated, those with spreading peritonitis and those with abscess.

TABLE VIII
Leukocyte and Differential Counts

Diagnosis	Mean count	Mean per cent of polymorph count
Unperforated cases	17,400	84
Spreading peritonitis	18,900	85
Abscess	20,700	86

From a prognostic or diagnostic standpoint no deductions could be drawn

Diagnosis—It is unfortunate that our records do not show accurately the number of mistakes that were made in diagnosis, however, we do know that during the period that this series covers, six cases of pneumonia were operated upon for acute appendicitis, 5 lobar pneumonias, 4 of the right lung and one of the left, and one case of right bronchial pneumonia with diaphragmatic pleurisy. There were 2 cases of pneumococcic peritonitis which were mistaken for peritonitis caused by appendicitis and at least 2 cases of mesenteric lymphadenitis.

In one child of 2 years of age an abscess mass was mistaken for an intussusception. In another, a non-rotated cæcum with a perforated appendix situated under the liver caused a delay of two days in time of operation. And in 2 other children inflamed appendices which were adherent to the bladder caused urinary symptoms.

Hospitalization—Of those who lived, the number of days spent in the hospital bore direct relation to the time at which the operation was performed after the first symptoms appeared, and consequently upon the time at which the diagnosis was made.

TABLE IX
Relation of Time of Operation after Onset of Disease to the Time Patient Spent in Hospital

Time sick before operation	No. of cases	Mean time spent in hospital
1 day	43	16.9 days
2 days	29	20.6 days
3 days	26	23.6 days
4 days	12	29.9 days
5 days	7	34.6 days
6 or more days	17	25.5 days

Those cases which were closed without drainage spent an average of 14.2 days in the hospital, the unperforated appendices, which were drained, 19.1 days, spreading peritonitis 24.6 days, and the abscess cases 27.6 days, the average number of days for all cases was 22.3.

Conclusions and Comments The outstanding fact brought out in this analysis is that an early diagnosis with operation reduces mortality, prevents development of complications, shortens convalescence, and makes sequelæ, such as incisional hernia, less apt to develop. While this is not new, since every recent statistical paper on acute appendicitis has demonstrated the same, it is worthy of repeated emphasis.

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The incidence of the disease in children is of interest. In the very young (under five) it is a comparatively rare condition, gradually increasing in frequency until adolescence when its occurrence is as common as in the young adult. Bancroft * in his series of 584 cases had 65, or 11.1 per cent, in the first decade, while the author † in a previous analysis of 500 cases had 42, or 8.4 per cent. Our youngest case was 20 months and only 11.7 per cent were under the age of 5 years. Undoubtedly in a large number of children under 5 years of age acute appendicitis is not recognized, but yet the incidence would not seem to be as great as in the second five years of life.

The morbidity and mortality has an inverse relation to the incidence. In the young (under 5 years) the prognosis is grave, almost all perforate (100 per cent in this series), and the mortality among these was 35 per cent. As the age increases the mortality decreases. For the second five years it was only 3.1 per cent, for the whole of our series 7.5 per cent, and for the first decade 9.8 per cent. Bancroft showed a mortality of 10.9 per cent for the first decade and 2.4 per cent for the second decade, and Beekman, Smith and Everingham had 16 per cent for the first and 1.2 per cent for the second. The higher mortality in the young would appear to be due first, to difficulties in the diagnosis, and second, to the failure of the peritoneum to wall off the process and the lack of resistance of the individual. As adolescence is approached the resistance of the body is increased and peritonitis is less commonly seen. If the cases under five years of age were eliminated our mortality would have been 3.9 per cent instead of 7.58 per cent, which is approximately the same as is found among adults, Bancroft's mortality being 4.2 per cent and the author's previous series 6.8 per cent. In children, if operation is performed before perforation takes place, the mortality should be almost nil.

Acute appendicitis is twice as common in boys as it is in girls, but the mortality for the latter is double that of the former. This is similar to conditions found in the adult. Bancroft had 63.7 per cent males, 36.3 per cent females, with 3.7 per cent mortality of males, and 5.2 per cent females.

Perforation is much more common among children than in adults and spreading or diffuse peritonitis is relatively more frequent than abscess formation.

	S preading peritonitis	Abscess
This series (children)	34.4	36.4
Bancroft (all ages)	10.8	22.8
Beekman, Smith and Everingham (all ages)	9.0	21.0

The mortality of cases with spreading peritonitis or abscesses is about the same as found in a general series.

The convalescent post-operative complications, with the exception of secondary abscesses, developed in about the same numerical proportion as in the adult, though they were not as varied. We did not see any cases

* Jour. Am. Med. Assn., 1920, vol. lxxv, pp. 1635-1638.

† Beekman, Smith and Everingham. Am. Jour. Med. Sc., 1917, vol. cliv, p. 490.

with post-operative phlebitis or emboli. Secondary abscesses were much more commonly found than in a general series. We had 10.3 per cent of these, Bancroft 4.2 per cent, and Beekman, Smith and Everingham 2 per cent. This may be accounted for by the apparent fact that children wall off infection with adhesions slower than adults allowing a dissemination of pus among the coils of intestines. No serious complications developed in any of our undrained cases.

Incisional hernia followed operation for acute appendicitis much more frequently than in adults, in this series 12.8 per cent. Bancroft reports for the first decade 17.1 per cent and for his general series (all ages) 9.8 per cent. General bulging of the muscles to the mesial side of the scar, which was so often found shortly after operation and which later disappeared, was probably due to transitory injury to the innervation of this part of the muscle and was corrected when the axis cylinders of the efferent nerves were reestablished. Bancroft reports the same condition in adults, which he did not class as hernia.

Predisposition to hernia is more common in younger children than in those approaching adolescence. This can be explained by the apparent poorer resistance to infection, with a longer convalescence, and less highly developed musculature.

All the cases that later developed hernia, except one, had some loss of tissue of the abdominal wall or a separation of the edges of the wound. The loss of tissue was from sloughing in wounds that had become badly infected from the secretion about the drains. The amount of slough apparently depended upon the virulence of the infection and interference with blood supply by sutures or the pressure of products of inflammation confined between tissue planes. It would seem that the important factor is the breaking down of the wound in the peritoneum. The peritoneum is adherent to the transversalis fascia. When closed the two are sutured as one, the plane of the serous surface remaining parallel with the planes of the abdominal wall and being strengthened by the transversalis fascia. This should prevent protrusion of abdominal viscera until the other elements of the abdominal wall have healed. If the wound in the peritoneum sloughs, the edges of the peritoneum and transversalis fascia are separated and there is also sloughing of the superficial layers and more or less protrusion of abdominal contents. The serous surface now closes over by continuity, the edges of the transversalis fascia remaining separated. As the edges of the serous surface advance they are deflected outwards by the protruding viscera and finally come in contact with the under surface of the skin, which is also healing by continuity. The peritoneum adheres to skin and prevents the edges of the separate layers of the abdominal wall from coming into contact with each other. Thus if sloughing of the wound is prevented, hernia should follow less frequently.

Bancroft states that upon the Second Surgical Division of the New York Hospital "It has been the general principle to make the incision in the fascia

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and muscles comparatively small in order to diminish post-operative sloughing in the drained cases, when the incision is large it is necessary to suture the aponeurosis, thereby burying foreign bodies and interfering with the blood supply of a tissue, early subject to bacterial infection" "In the case in which drainage is employed, if the incision is small, only the peritoneum is united about the drain, no sutures being placed in aponeurosis, muscle or skin" With the above procedure the peritoneal edges are coapted, and as there are no products of infection in close contact and under pressure to interfere with circulation, the peritoneum heals by primary union, its continuity being in its original plane and not out towards the skin surface. The muscle bundles tend to come together over it because of the direction of their pull, but do not inclose infectious material which might otherwise cause necrosis of tissue, and the aponeurosis and skin, being left wide open, allow free drainage. In recent cases drained in this manner the wounds heal with no sloughing, their surfaces being covered only with a small pyogenic membrane which soon disappears. The muscle fibres adjust themselves over the peritoneum which has healed by primary union, and complete healing of the wounds is shortened, as they do not need re-opening to allow for drainage of sloughing tissues.

Like most diseases in childhood acute appendicitis starts abruptly, the child suddenly being seized with acute abdominal pain and soon after vomiting. Vomiting is an almost constant symptom, being present in 85 per cent of the non-perforated cases, 97.7 per cent of the peritonitis cases and 83 per cent of those with abscesses. It is such a common practice to give cathartics to children as soon as they complain of pain in the abdomen that almost all of the patients admitted to our wards for appendicitis have had some form of purgation. If they had not vomited before, they usually emptied their stomachs after its administration. It would seem quite probable that cathartics are accountable for a large number of the early perforations which take place in children.

All children with acute appendicitis show some rise of temperature, it is seldom high, usually under 103° . Cases with spreading peritonitis usually have a higher reaction than those with abscesses or the unperforated cases.

The pulse is accelerated in all cases but is not as rapid as might be expected, except in those who are markedly toxic.

The respiratory rate appears to be increased, apparently in proportion to the amount of peritoneal surface involved, as it is highest in the perforated cases and lowest in the non-perforated.

Apparently more can be told of what condition is present from careful examination of the abdomen than by any other means. In the unperforated cases the tenderness and rigidity was usually pretty well localized on the right side of the abdomen, while in the cases suffering from diffuse peritonitis these signs were quite uniformly general. In the unperforated cases the rigidity at times was absent. With abscess formation the tenderness was well localized with right-sided rigidity and oftentimes a mass was felt either

by abdominal or rectal palpation. It must not be forgotten that at times the cæcum is not completely rotated and the physical signs are not what might be expected.

The leucocytes and differential counts are of importance to confirm diagnosis, but are of little value from a prognostic standpoint. They are always higher than normal. The number of leucocytes is seldom larger than 30,000 and polymorphonuclears higher than 94 per cent. As a general statement it can be said that cases with abscesses have the highest counts, spreading peritonitis less, and the unperforated cases have the lowest.

Mistakes in diagnosis would seem to be inevitable but should be reduced to a minimum. Differentiation of early pneumonia with abdominal symptoms before definite physical signs appear in the chest is difficult. It would seem to be better to err on the side of operating than to wait with the danger of a diffuse peritonitis. Mesenteric lymph adenitis and pneumococcus peritonitis are often mistaken for acute appendicitis. Convalescence can be much shortened by operating upon cases early in the disease, before drainage is necessary.

SUMMARY

1 The earlier diagnosis is made and operation performed, the lower is the mortality, the fewer are the complications and the shorter is the convalescence.

2 Acute appendicitis in children is more frequent as adolescence is approached.

3 With the exception of children under five years of age, in whom it is extremely high, the mortality is about the same as is found among young adults.

4 The disease is found twice as commonly in boys as in girls, the mortality being about twice as great among girls as boys.

5 Perforation of the appendix with spreading peritonitis or abscess formation occurs more often in children than in adults.

6 Immediate post-operative complications are as commonly found in children as in adults, with the exception of secondary abscesses which are seen more often.

7 Incisional hernia follows operation in children more often than in adults. Sloughing of muscles and aponeurosis, secondary abscesses and partial evisceration of portions of the abdominal contents appear to be the causative factor.

8 Mistakes in diagnosis would seem to be inevitable and it would appear better to err by operating.

In conclusion I wish to express my thanks to Dr. Carl Burdick, who is in charge of the Children's Surgical Service, 4th Division, Bellevue Hospital, for the privilege of reporting these cases.

FRACTURE OF THE ANTERIOR SUPERIOR SPINE OF THE ILIUM BY MUSCULAR VIOLENCE*

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FRACTURES by muscular violence, while rare, are always of interest, especially in the mechanism of production. Fracture of the anterior superior spine of the ilium in this fashion has occupied the attention of surgeons since 1870. Matti¹ and Ruppert² consider it a typical avulsion fracture, relatively infrequent, and Cotton³ and Speed⁴ think it rare. To those who came before the inception of the X-ray falls a great deal of credit for the accuracy and precision with which this diagnosis was made.

The anterior superior spine is developed from the iliac crest, one of the five secondary developmental centres of the os innominatum. John Poland⁵ states, "some osseous granules which show themselves in the cartilaginous margin of the iliac crest, congregating especially at two points in the front and back parts to form the anterior and posterior spinous processes are often seen at the fifteenth year. Beclard fixed the commencement of the osseous development at the sixteenth year. At the nineteenth to twentieth year two thick and broad epiphyses are seen, the anterior one forming the anterior superior iliac spine and the anterior three-fourths of the iliac crest, the posterior one the posterior superior iliac spine and contiguous part of the crest. More often these two parts are united into one long epiphysis capping the iliac crest. This epiphysis does not join the body of the ilium till the twentieth to the twenty-fifth year, usually at the twenty-first year." Doctor Orr, quoted by Albertin,⁶ and also Dwight⁷ are in accord with this development. A separation, then, of the true osseous epiphysis can only occur from the fifteenth year, the time of its formation, to the twenty-fifth year, its union with the body of the bone. The anterior superior spine has attached to it numerous muscles. The sartorius, tensor fasciæ femoris, external and internal oblique, transversalis, gluteus medius, the iliacus on the inner aspect, the fascia lata and Poupart's ligament. The periosteum forms a strong sheath about the epiphysis, so much so that on its removal the epiphysis may be readily detached from the body of the bone. The blood supply of the epiphysis comes from the periosteal network of arteries and one or two small vessels from the diaphysis, which perforate the conjugal cartilage. So a separated epiphysis does not necrose because its blood supply is almost entirely independent of that of the rest of the bone.

As to whether this is a fracture or an epiphyseal separation, there is some discussion in the literature. Tanton⁸ says that it can occur as an epiphyseal

* Read at The Orthopædic Section, New York Academy of Medicine May 18, 1923

separation in an infant and an adolescent up to sixteen or seventeen years, the age of ossification of the spine. In an editorial article, *Lancet*⁹ states, "As the epiphysis of the spine does not unite with the body of the bone until the twentieth to the twenty-fifth year, these accidents may be regarded as separation of epiphyses." On the other hand, the *Dictionary of Dechambre-Poirier-Testut* claims an epiphysis only for the anterior inferior spine. McHenry,¹⁰ as one of his conclusions, gives the following: "In all cases the diagnosis might be said to be a separation of the epiphysis rather than a fracture of the anterior superior spine of the ilium, but in each case the whole epiphysis was not separated (i.e., the iliac crest in its entirety) but only a small portion of it which has no separate centre of ossification from the rest of the iliac crest, and therefore 'fracture' seems to be after all the more correct term." Turner¹¹ states, "the anterior superior spine is developed as part of the secondary centre from which the whole iliac crest arises, so that its separation is not complete without fracturing across the remainder of the epiphyseal plate. It cannot, therefore, be considered as a pure diastasis." The inclination of the writer is to favor the opinion of the last two men.

The mechanism of the production of this fracture is interesting. The keynote is hyperextension of the trunk on the thigh. Corlette¹² lays great stress on the sudden contraction of the sartorius. Rieffel¹³ feels that this fracture is caused mostly by a contraction of the fascia lata. The lesion most common is that which detaches the spine along with a part of the crest. In this connection it is also interesting to note that Tanton⁸ observed a similar fracture in young race horses, which, however, he could not verify in the veterinary literature. Stimson¹⁴ says, "considering the strength of the muscles attached to the ilium and the occasional correspondence of the fragments to the insertion of the muscles, the theory (muscular action) does not seem unreasonable." Reverdin¹⁵ thinks that to regain the equilibrium the trunk is flexed on the thigh. The flexors, the sartorius and the tensor fasciæ femoris are in active contraction. In slipping there is hyperextension of the trunk on the thigh which causes a violent contraction to bring the body forward. In the opinion of Albertin, epiphyseal separation by contraction of the muscles attached to the bony parts is rare but a violent muscular contraction can break the continuity of the parts at the level of the cartilage. In discussing his case, Brown¹⁶ says that on taking off before jumping the pelvis is raised suddenly by the action of the muscles which lie between the ribs and ilia. In a long "take off" with the right foot, the strain will be greater on the right side, and *vice versa*. Tanton⁸ is convinced that the fracture is most commonly due to muscular action. Ruppert² attributes it to the muscular action of the sartorius, gluteus medius and tensor fasciæ femoris. Speed⁴ gives the following mechanism as probable: "In running the leg involved is stretched way out behind as a step is being taken with the opposite leg. The ground may give way or the foot slips so that simultaneously with the hyperextension an outward rotation of the leg takes place. This passes the limit of extension permitted in the hip-joint and the spine is pulled off by the muscles attached

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to it" According to Matti¹ there is an uncoordinated action of the muscles when anyone tries to straighten out in slipping Tillmans¹⁷ mentions the fracture as due to the pull of the tensor fasciæ femoris and sartorius

The following case is presented as belonging in the group under consideration

A high school student of fifteen presented himself in April, 1921, complaining of severe pain in the region of the right groin, especially on walking, which he had for one day His past history was irrelevant The day previous, while running a relay race, he found that after about fifty yards, he was incapacitated because of a knife-like pain in the right groin On close questioning he volunteered the following information In preparation for the race he assumed the "take off" with the left foot in front of the right On the "take off" with the sudden straightening of the body, he was partially disabled by the severe pain described before, and by a snap which he felt in the right groin After quitting the race, he walked to a car with a limp and then continued part of the time to walk about his home The next day he descended two flights of stairs and all-in-all walked about five blocks to see me On examination he



FIG 1 —X-ray picture taken twenty-four hours after the injury, showing complete detachment of the anterior superior spine

was seen to walk with a distinct limp on the right side and with the trunk bent forward and to the right Hyperextension and hyperflexion of the thigh on the pelvis were possible only with great difficulty because of pain in the iliac region There was a little fullness in the anterior portion of the iliac crest, and here there could be felt a piece of bone about $2\frac{1}{2}$ cm in diameter which moved slightly on the deeper parts, with crepitus This area was exquisitely tender There was only slight ecchymosis A tentative diagnosis of fracture of the anterior superior spine was made and the patient was referred for immediate X-ray, (Fig 1) which confirmed the diagnosis The anterior superior spine was torn from the epiphysis of the iliac crest completely, and was rotated outward The patient had an oblique strapping applied and was advised to ride home and

stay in bed for two weeks with a pillow underneath the knees. Here the patient fell out of my hands and consulted Dr. William F. Campbell, of Brooklyn, who has been kind enough to allow me the use of his notes. In two weeks, the patient was discharged with the anterior superior spine firmly united to the body of the bone and with practically perfect function. At the time of this report, two years later, the boy still continues his athletics and has no symptoms or disability from his fracture.

It is quite evident that the mechanism in this case was hyperextension of the trunk on the thigh and a strong pull of the sartorius and tensor fasciæ femoris.

The following cases have been recorded in the literature, the last of which, however, is a verbal communication from Dr. Leo Mayer of New York.

JOY AND McWHINNIE¹⁵—A medical student of seventeen was in a foot race in which he had to turn back. In the exertion of turning he felt something snap, walked a few steps and fell. On examination the fragment of the anterior superior spine was felt and by placing the thumb over the origin of the sartorius and retaining the thigh, crepitus could be felt. The patient was put to bed with the thigh flexed and was well in two weeks without displacement of the fragment.

SEELEY¹⁹—A young man of seventeen of good muscular development while running vigorously in a football match, was suddenly brought to a stand-still by a snap in his side followed by a feeling of "coming in two." Being quite unable to take another step, he was carried to the house and on examining him an hour afterwards, considerable tenderness was found along the upper head of the rectus femoris and a piece of bone as large as the top of the finger detached from the ilium. Crepitation was very distinct.

HIDE²⁰—A young man of eighteen while running over some uneven ground, suddenly felt as if a stone had been thrown at him striking him on the hip and then he felt that he could not move again. He was carried home and on arrival an hour afterwards, it was found that he was unable to draw his legs forward and one head of the rectus femoris was torn from its attachment to the ilium with a piece of the bone, about the size of a half damson, perfectly movable, so much so, that distinct crepitus could be felt by moving the surfaces of the fractured parts together. The thigh was flexed and a pad applied with a figure-of-eight bandage around the pelvis and thigh. At the end of two weeks union had taken place with formation of callus and in another week was able to walk about without difficulty.

BROWN²¹—A strong boy of seventeen was long-jumping in the course of some sports on March 18. Just as he was commencing to jump, after having finished his run (taking off in technical language), he felt a sudden snap on the right side of the pelvis and fell being in considerable pain. He fainted and was carried indoors. When seen about fifteen minutes after the occurrence he got over his faintness but was a little shivery and collapsed. On examination, it was found that he could not stand and though each hip joint moved naturally, movements in the right hip joint caused pain in the lower part of the abdomen on that side. Coughing and passing water also caused pain in the same place. The right anterior superior spine was not to be felt in its place but a rough piece of bone was felt instead of it. All around this was a considerable hematoma while the spine itself was distinctly felt displaced upwards and a little inwards. With the abdominal muscles relaxed it could be brought back to its proper position and marked crepitus elicited, though of that sort character which is noticeable when epiphyses are detached. He was put to bed and kept literally on his back for ten days, the right hip being fixed with a stout splint and a pad of lint assisting to keep the displaced fragment in apposition with

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the rest of the bone. In about a week the hæmatoma was reabsorbed and crepitus could still be elicited. At the end of a fortnight, he was allowed to move about a little, keeping the hip-joint fixed with a well-made elastic silk spica. By this time crepitus could no longer be elicited and after eight weeks he ceased wearing his support and felt in every way strong and well. This boy jumped from his right leg and called into sudden and violent action his external and internal oblique and transversalis muscles, separating the spine from the body of the bone.

ALBERTIN⁶—A young man of seventeen, well built, had no antecedent disease of the skeleton. Two days previously the patient ran with moderate speed, when, due to an inequality in the level of the ground, the patient fell. The left leg was twisted inward and behind the right leg. Seeing that he was about to fall, he tried to recover himself by reversing the movements. He was then thrown obliquely backward on the left side but the body did not touch the ground. He lifted himself up as soon as he felt severe pain just external to the fold of the groin on the left side. He could not walk after the fall and limped. Examination showed no ecchymosis. Palpation of the anterior superior iliac spine gave definite tenderness. In endeavoring to ascertain more definite information concerning deformity, bony mobility was noticed corresponding to the triangular projection formed at the anterior superior spine of the ilium. One could grasp the bony fragment and make it slide deeper, giving definite crepitation. This mobility increased with flexion of the thigh on the abdomen and diminished with complete extension. The diagnosis of fracture of the anterior superior spine was then made. In fact, because of the insertion of the sartorius at this level, the release of this muscle permitted mobility of the bony portion above its insertion. Flexion of the thigh on the pelvis, adduction and external rotation increased the mobility of the detached fragment. Extension, adduction and internal rotation fixed the fragment. This phenomenon of immobilization of the epiphysis appears to be due more or less to complete integrity of the periosteal sheath, thus, bringing about that the epiphysis, although detached from the bone at the level of the cartilage, nevertheless, remains adherent because of its periosteal covering. Flexion of the thigh on the pelvis was not stopped but it was done with difficulty. Besides, in trying this movement the patient experienced a sharp pain at the upper insertion of the sartorius. We have clearly a case of detachment of the anterior superior spine by violent contraction of the sartorius. The patient is very positive on this point. The left hand alone touched the ground. The manner in which the fall was produced, the sudden recovery and backward turning required a violent muscular contraction. That bony portion which takes its insertion above the sartorius was torn during the effort. The treatment was rest in bed without an apparatus because of slight displacement of the fragment. In eighteen days there is a large callus at the level of the tear and the patient walks without pain.

NICKERSON²¹—A boy of seventeen, while running a foot race of 100 yards was brought to a stop by a feeling of something giving way in his hip with a sensation of the bones grating together. He could not take another step. On examination, the large fragment of the anterior superior spine could be felt, there was crepitus and tenderness. The leg was placed in the flexed position, the patient began to walk continuously at the end of two weeks with crutches and in three weeks dispensed with them, though using care in going up and down stairs.

HAMILTON²²—A man of seventy, after riding in a railroad car, in about one-half an hour, arose to leave his seat when he "felt something wrong" in his right groin and found himself unable to walk again without great pain. He was admitted to Bellevue Hospital the same day and a fracture involving about three inches of the ilium including the anterior superior spinous process was found. It was inclined to fall outwards but was easily replaced with distinct crepitus.

CORLETTE¹—A young man of seventeen years and eight months was getting down from the top of a bus from behind when the bus suddenly went forward causing him to slip and lose his footing. He came down with his whole weight on the right foot and immediately felt a pain in the region of the anterior superior iliac spine. He fell forward and could not rise. On being assisted up, he could stand on the left leg but could bear very little weight on the right, the attempt causing pain. When examined and made to stand, he stood bent forward with the right hip and knee partly flexed with the toes touching the ground and turned slightly inwards. On lying down, passive movement of the hip could be done freely without causing pain so long as the hip was not extended beyond a certain point. On comparing the two sides, there was an evident loss of prominence over the situation of the right anterior superior spine where the patient complained of pain. Manipulation caused great pain, closely localized and distinct crepitus was obtained at the spot complained of. There was no pain or tenderness anywhere else. The patient was treated by fixing a high pillow beneath the knee, thus flexing the hip. A considerable amount of callus subsequently formed.

REVERDIN¹—A muscular young man of nineteen at the moment of the break in a wrestling match on slightly sloping ground, experienced a twinge of pain but at the instant of bringing his right leg in front, the left slipped on the ground. He made an effort to right himself at the same time, feeling at the level of the anterior superior spine a sudden severe pain. He noticed at the same time that he could not stretch his leg and he let it fall voluntarily to the ground. He could not walk. The limb was put in semiflexion by cushions and a bandage was applied with the idea of obtaining good approximation. Five hours later, on examination, there was very little swelling. Active and passive movement of the thigh was impossible because of pain. A furrow was felt 3 or 4 mm in length, the anterior lip of the furrow being several mm lower than the posterior. Beyond the furrow is a movable bony fragment corresponding to the detached iliac spine. There is slight swelling in the neighborhood of the external iliac fossa. The thighs were put in semiflexion, wet dressings applied, and a course of massage begun. On the third day crepitus was elicited, the fragment was triangular, there was a half cm difference in distance between the spine and the pubis. The fragment was depressed. Four days after, plaster cast applied embracing the two hips and upper part of the left thigh which was kept in flexion. On the eighth day through a window in the cast, the fragment was kept in position by a tampon of gauze and fixed by a spica. On the fifteenth day, the local condition excellent. The union was good but on attempted motion of the fragment pain was elicited. The furrow, on running the finger along the crest was one mm in size. On the nineteenth day the cast was taken off, the fragment was well held, the patient walked without pain, extension and flexion being free. On the twenty-first day there was weakness of the limb and a slight furrow was still seen. There was a hard bony swelling due to the callus. On the left side the distance between the spine and the pubis was 1 cm less than on the right. In about one month the patient could play tennis. The X-ray showed the fragment below and internal. The mechanism could be summed up as follows. The patient tried to regain his equilibrium by flexing his trunk on the left thigh. The flexors were involved in energetic contractions, and the sartorius and tensor fasciae femoris which are attached to the anterior superior spine, on slipping, produced a movement of hyperextension of the trunk on the thigh which caused a violent contraction to bring the body forward.

BEFFE²—A young man of nineteen "was making a spurt in a 125-yard race, when he heard a snap and felt a sudden sharp pain in his right hip and a sensation of something giving way so that he put his hand on his hip to give support

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He felt pain on drawing his leg back relieved by bringing it forward but kept running and won the race" On examination forty-eight hours later, he walked with a limp The anterior superior spine was blunted and vague in outline It was very tender Beneath this skin there was a hard angular mass movable without crepitus Flexion of the thigh was painful Two weeks later he walked without perceptible limp In six weeks he could use his leg well

BRICKNER²⁴—A boy of seventeen, a few hours before, had run a 100-yard dash He started in a crouching position with the right leg drawn back At the signal he pushed himself forward by this leg At the same instant he "felt something snap" He was able to run, however, and with sufficient speed to make an excellent finish He walked about after the race with but slight limp and suffered pain only on active flexion of the right knee (contraction of the sartorius) There was distinct mobility with crepitus of the right anterior superior spine Recovery in three weeks

STEINTHAL²⁵—This author just mentions seeing a case in a young woman who was dancing

COTTON²⁶—A young man of nineteen was sprint racing when something gave way He did not fall, but could not finish A movable fragment could be made out displaced downward There was pain on lifting the thigh and tenderness Prompt union took place

SKILLERN²⁷—A male, sixteen, during a foot race felt something snap in the upper part of the left thigh, but he finished the race Pain was aggravated by flexion of the thigh The lesion was shown by X-ray It was probably caused by action of the sartorius

McHENRY¹⁰—A boy of seventeen, on June 20, 1908, while running a foot race, completed it a winner and then came to a sudden stop, feeling something give way in his right side and pain He could walk no further On examination the boy was found muscular, he could not stand, and as he lay the right foot was turned inward, and he could not lift his heel from the table There was found swelling, crepitus, and tenderness over the right anterior superior spine with no ecchymosis When the knee was flexed, crepitus could be obtained The fragment could be felt and moved, but less when the limb was extended X-ray showed a fracture of the anterior superior spine with a fragment $3\frac{1}{2}$ cm long, with a shape and size of an almond, being displaced downward and inward The fragment was replaced and held in fixation by a pad and strapping, with the leg flexed at the knee On the twelfth day, there was no pain tenderness, or crepitus On the eighteenth day, he got about on crutches, and on the twenty-first day the X-ray showed firm bony union In several days he attained a normal gait

TURNER¹¹—This case was seen in 1897 The patient was a strong lad of eighteen, who was running very quickly when he felt something snap above or about his left hip "He went out of his stride," and after struggling for a few paces, fell to the ground He was seen in one hour and walked very lame with both the thigh and leg slightly flexed The anterior superior spine could be felt separated from its attachment and crepitus was obtained The next day an incision was made to the injury and it was found that the separated fragment carried the attachment of the sartorius with it, while the abdominal muscles attached to this part of the crest, were partially torn The fragment was fixed to the ilium with silver wire Recovery was uneventful, and when the patient was seen one and seven years later he had no disability

ALER²⁸—A young man of twenty-three, in attempting to kick a football, missed it He felt weak on his right side when he attempted to walk but he was able to limp to the hospital He suffered little pain except on forward flexure of the thigh Examination showed the skin over the anterior superior spine slightly

depressed There was crepitus The fragment was replaced and the thigh flexed and abducted

RUPPERT²—An eighteen-year-old servant was running a race and on the "take-off," with his right foot forward he felt a severe pain in his right hip, which caused him to run a few more feet and then he lay down on the ground On examination he had pain in the region of Poupert's ligament on extension of the hip He was able to stand on the right leg without trouble The spine the size of a nut, was about 1 cm below the usual place and it could easily be felt and moved with crepitus It was very tender The patient was able to get about in a few days

JALIN²⁵—A young man of eighteen ran very fast in a race All of a sudden he felt at the level of the anterior superior spine a severe pain, which made him

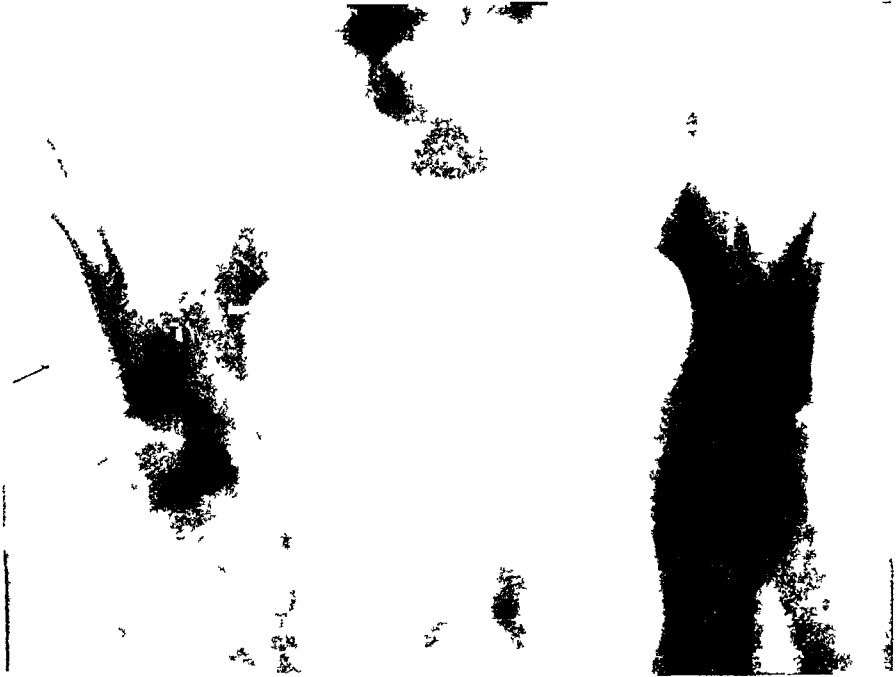


FIG 2—X-ray picture of Dr Leo Mayer's case taken three weeks after injury the arrow showing the detached fragment pulled down about 5 cms

fall before the finish of the race Dr Le Page Rene made the diagnosis of separation of the right anterior superior spine At this level there was abnormal mobility and crepitus On the left, one could only make out flatness and pain The loss of function was due most or all to the pain The man could not walk, unless supported by two people It was produced at the epiphysis not yet ossified

MAYER, LEO, New York (Verbal communication) —A young man of seventeen, while running in a football match was seized with severe pain in the right groin He continued playing and walked about for three weeks with some pain On examination there was marked tenderness just beneath the right anterior superior spine About one inch below this a hard mass seemingly bone, could be palpated X-ray (Fig 2) showed a fracture of the ilium and a downward displacement of the fragment of bone On October 10, 1922, about 3½ weeks after his injury, operation was performed A 5-inch incision from the anterior portion of the iliac crest downward over the anterior superior spine was made On opening the fascia just below the spine, there was a gush of bloody serum and a cavity two inches deep by one and one-half inches long was opened up The lower wall of this cavity was formed by a piece of bone the size of the terminal

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phalanx of the thumb By flexing the hip about 150° it was possible to bring this fragment of bone back into position and hold it there by two kangaroo tendon sutures Plaster-of-Paris from ribs to knee applied Eighteen days later, the bone was in excellent position Twenty-five days after the operation, the patient could walk with a limp In about six weeks, the patient walked well and the bone was firmly healed

Conclusions From an analysis of the total number of cases, twenty-one, the following facts may be gathered

- 1 The fracture is infrequent
- 2 All the patients were males, a large percentage of whom were athletic and muscular One case, not completely described, was in a female
- 3 The average age in the epiphyseal stage is $17\frac{1}{2}$ years, the youngest 15, the oldest 23 There was one case at the age of 70
- 4 The etiological trauma was Running vigorously, 50 per cent, "take off," 16 per cent, running over uneven ground, 9 per cent, sudden turn backward, 5 per cent, rising out of seat, 5 per cent, slipping, 5 per cent, wrestling on sloping ground, 5 per cent, kicking, 5 per cent
- 5 All had pain
- 6 A snap was felt by 45 per cent
- 7 The fragment was felt in 90 per cent
- 8 All the patients limped, 76 per cent had immediate disability, 11 per cent walked a short distance, 1 case could walk 48 hours later, and 1 case walked about for 3 weeks
- 9 The side involved is not given in six instances One case had both sides fractured Of the remainder, 75 per cent were on the right side and 25 per cent on the left side
- 10 The average duration of the disability in the nine unoperated cases in which it is mentioned is 20 days Two cases were operated, both of which had return of function in about one month
- 11 The end result is excellent in all

REFERENCES†

- ¹ Matti, H Die Knochenbrüche und Ihre Behandlung, Band 11, 1922
- ² Ruppert, Leopold Eine Abrissfractur der Spina Iliaca Anterior Superior Wien Klin Wchnschr, vol xxvii, 1914, p 700
- ³ Cotton, Frederic J Dislocations and Joint Fractures, 1910
- ⁴ Speed, Kellogg A Text-book of Fractures and Dislocations, 1916
- ⁵ Poland, John Traumatic Separation of the Epiphyses, 1898

† Tanton mentions two cases given by Le Bot and Emmert The literature on these has not been available

Stimson and Brickner mention two cases reported by Whitelocke in Lancet, November 25, 1893 This probably was an error in transcription as the title of the paper is "The Detachment of the Epiphysis of the Anterior Inferior Spinous Process of the Ilium Through Enforced Muscular Action"

- ⁶ Albertin Note sur un cas d'arrachement de l'épine iliaque antero-supérieure par la contraction musculaire du couturier La Province Médicale, 1887, p 741
- ⁷ Dwight, Thomas The Range and Significance of Variations in the Human Skeleton Boston Med & Surg Jour, July 26, 1894
- ⁸ Tanton, J Le Dentu et Delbet Nouveau Traite de Chirurgie, vol 11, 1916
- ⁹ Editorial Article Lancet, Sept 4, 1909
- ¹⁰ McHenry, Junius H Fracture of the Anterior Superior Spine of the Ilium by Muscular Contraction with Review of the Literature Cleveland Med Jour, August, 1909
- ¹¹ Turner, G Grey Lancet, September 4 1909
- ¹² Corlette Cyril Ernest Australian Med Gaz, March 15, 1895, p 99
- ¹³ Rieffel H Le Dentu et Delbet Traite de Chirurgie, vol 11, 1896
- ¹⁴ Stimson Lewis A Fractures and Dislocations, 1899
- ¹⁵ Reverdin, J L Arrachement de l'épine iliaque antero-supérieure par contraction musculaire Rev med de la Suisse Rom Geneve, 1899, vol 11, pp 757-760
- ¹⁶ Brown, Clarence Haig Separation of the Anterior Superior Iliac Spine by Muscular Action British Med Jour, August 16, 1884, vol 11
- ¹⁷ Tillmans, H Die Verletzungen und Chirurgischen Krankheiten des Beckens, 1905, D chir S 64
- ¹⁸ Joy, S, and McWhinnie, J Wallace Canada Med Jour, August, 1870, vol 11 N Y Med Jour, September, 1870, vol 11, p 184
- ¹⁹ Seeley, George J British Med Jour, 1872, vol 11, p 549
- ²⁰ Hyde, W E British Med Jour, 1872, p 513
- ²¹ Nickerson, N Deutsche med Wchnschr, March 6, 1890 Boston Med and Surg Jour, vol 111, No 10, 1890
- ²² Hamilton, Frank H A Practical Treatise on Fractures and Dislocations, 1891
- ²³ Bebec Edwin L N Y Med Jour, Nov 17, 1906
- ²⁴ Brickner, Walter M Fracture of the Anterior Superior Spine of the Ilium by Muscular Violence Amer Jour Surg December, 1906
Steinthal Handbuch der Practischen Chirurgie Von Bergmann, Bruns, Mikulicz, vol 11, S 792
- ²⁵ Skillern, Penn G, Jr ANNALS OF SURGERY, vol 111, p 289
- ²⁶ Auer, Charles Jour A M A, October 25, 1913
- ²⁷ Jaulin M Arrachement des deux apophyses iliaques anterieures et superieures par effort musculaire Jour de Radiologie et D'Électologie, vol 1, 1921, p 485

ADDENDUM—Forceful contraction of the sartorius as a cause of this fracture is assigned by Roberts and Kelly in their "Treatise on Fractures," 1916, and by William L Estes, Jr in Ochsner's "Surgical Diagnosis and Treatment," vol 11, 1922

PROGNOSIS IN GIANT-CELL SARCOMA OF THE LONG BONES

BASED UPON THE END-RESULTS IN A SERIES OF 50 CASES

BY WILLIAM B COLEY, M D
OF NEW YORK, N Y

(CONCLUDED FROM PAGE 357)

HISTORIES OF THE MORE IMPORTANT CASES

In an earlier paper on the subject, the writer reported in full the following case giant-cell sarcoma of humerus, amputation, death from metastases of lungs 15 months later

CASE I—H B, male, ten years of age, developed a rapidly-growing tumor of the upper end of the humerus, following a recent fracture Five weeks later the tumor showed such marked signs of malignancy, that I performed an immediate shoulder-joint amputation A microscopical examination was made by Doctor Ewing, who reported

"The process in the humerus proves to belong in the class of giant-cell sarcoma It consists of wide blood-space surrounded by thin strands of loose cellular tissue composed of spindle cells The spaces are partly lined by giant cells and some few giant cells are found within the strands of tumor tissue By far the larger part of the bulk of the tumor is made up of blood spaces The tumor has exactly the structure of the giant-cell epulis, and I think, therefore, that it has the same moderate degree of malignancy"

About a year later, the patient developed physical signs of metastases in the lungs, his general condition rapidly deteriorated, and he died in August, 1911, fifteen months after operation In reviewing this case, after the end result was known, Doctor Ewing stated that there was an error in the original diagnosis, and that it was a highly malignant osteogenic sarcoma The fact remains, that at the time of operation—the only time when the diagnosis is of vital interest to the surgeon and likewise to the patient—this tumor so closely resembled the benign giant-cell type that a pathologist of Doctor Ewing's great experience regarded it as such

CASE II—*Benign Giant-cell Sarcoma of Upper End of Tibia*—J N, male, nineteen years of age, no history of injury, was admitted to the Memorial Hospital on June 29, 1919, with the following history Two months before, curettage had been performed by Dr Walton Martin, of St Luke's Hospital, for a central tumor of the upper end of the right tibia, followed by an application of carbolic acid The patient was then referred to the Memorial Hospital for prophylactic treatment Doctor Ewing examined a section of the tumor, and pronounced it giant-cell sarcoma of the epulis type Another microscopical examination had been made by Doctor Knox (Resident Pathologist of St Luke's Hospital), who reported

"Sections show only tumor tissue very largely composed of atypical fibrous tissue, extremely vascular, and containing large numbers of giant cells and a very considerable amount of newly formed osteoid tissue Hemorrhage and extensive

* Read before the Southern Surgical Association, December, 1923

necrosis have occurred but in the more actively growing parts, the stroma is found to consist of large oval or spindle-shaped nuclei twisted about in ramifying bundles. Giant cells are found in all parts of the section. They vary greatly in size and somewhat in form. The nuclei are oval and well defined. The bone formation is occurring in the more rapidly growing fibrous portions of the growth and shows small stellate or irregular oval areas in which calcification has already

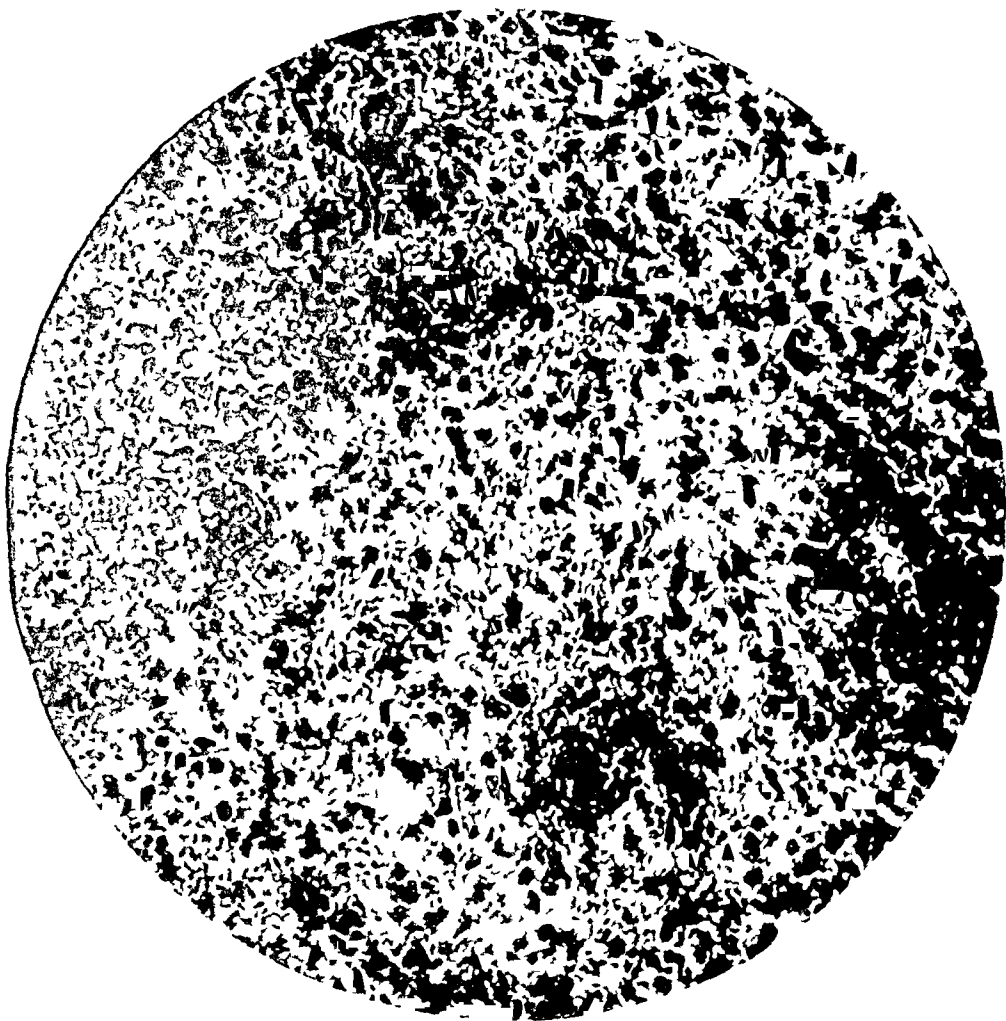


FIG 30 — (Case No. 16 in text: Giant cell sarcoma of upper end of tibia with involvement of knee-joint. Toxin's radium wound infected, amputation. Patient well 2 years later)

occurred. In places there is a homogeneous pink basement substance in which the cells are assuming the form of bone cells. Diagnosis: Osteosarcoma from head of right tibia. Contains giant cells." Report confirmed by Dr. Francis Carter Wood (Pathologist, St. Luke's Hospital).

At a conference of the members of the Memorial Hospital staff, it was decided that the case be treated with radium alone. Physical examination, at the time of his admission (July 16, 1919), showed a perfectly clean, healthy cavity in the upper end of the tibia. Into this cavity 47 mc. of bare tubes of radium wrapped in sterile gauze was placed and left there for 48 hours, a

PROGNOSIS IN GIANT-CELL SARCOMA

total of 2256 mc hours The patient was then treated in the Out-patient Department during the fall and winter of 1919, the sinus being dressed two or three times a week The cavity gradually healed up without infection and with apparently normal granulation tissue, but never entirely closed In April, 1920, the sinus suddenly began to show increased discharge, quickly assuming a fungoid appearance, protruding slightly beyond the normal surface, showing all the characteristics of a recurrent tumor Shortly after small hemorrhages occurred in the fungating mass, becoming more and more severe The patient was re-admitted to the Memorial Hospital on May 24, 1920 On June 4, 1920, I performed a second curettage,

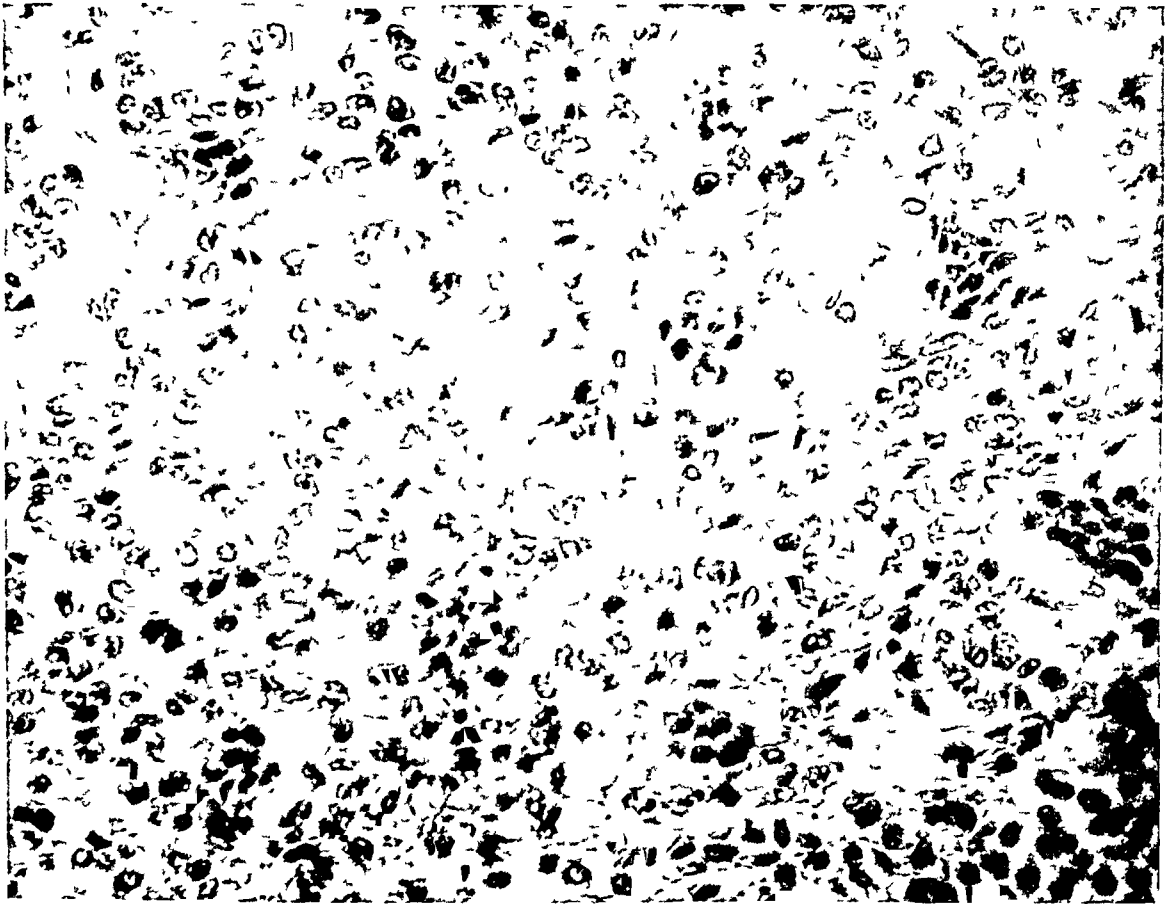


FIG 31 —(Case No 19 in text) Myelogenous giant-cell sarcoma of lower end of femur, curettage, toxins, recurrence, amputation Patient well 8 years later

with removal of a large amount of tissue resembling partially degenerated sarcoma, extremely vascular, leaving a cavity the size of a small orange

Doctor Ewing, who examined this tissue, stated that certain areas showed definite sarcoma, which he believed to be the same type as the original tumor, benign giant-cell sarcoma The hemorrhages recurred following curettage, infection developed, and the patient's condition became such that it was necessary to perform an amputation This was done on June 6, 1920 On section of the tibia, the whole upper end was found to be filled with a tumor mass which had nearly destroyed the cartilage, but not quite invaded the joint

Microscopical examination by Doctor Ewing "Section shows a large spindle-cell sarcoma with much oedema and widely dilated blood-vessels It resembles malignant osteogenic sarcoma"

On reëxamination of the original section removed at primary operation, Doctor

Ewing again pronounced it a benign giant-cell tumor. In January, 1921, the patient began to show evidence of failure in general health, and soon developed unmistakable signs of metastases in the lungs. An X-ray picture taken showed both lungs completely filled with metastases. The patient became extremely weak and emaciated, and died a few weeks later.

It is interesting to note that the original section of this tumor was examined also by Doctors Bloodgood, Wolbach, Mallory, and Stewart, of Leeds, and all pronounced it a typical benign giant-cell sarcoma. On the other hand, Doctor

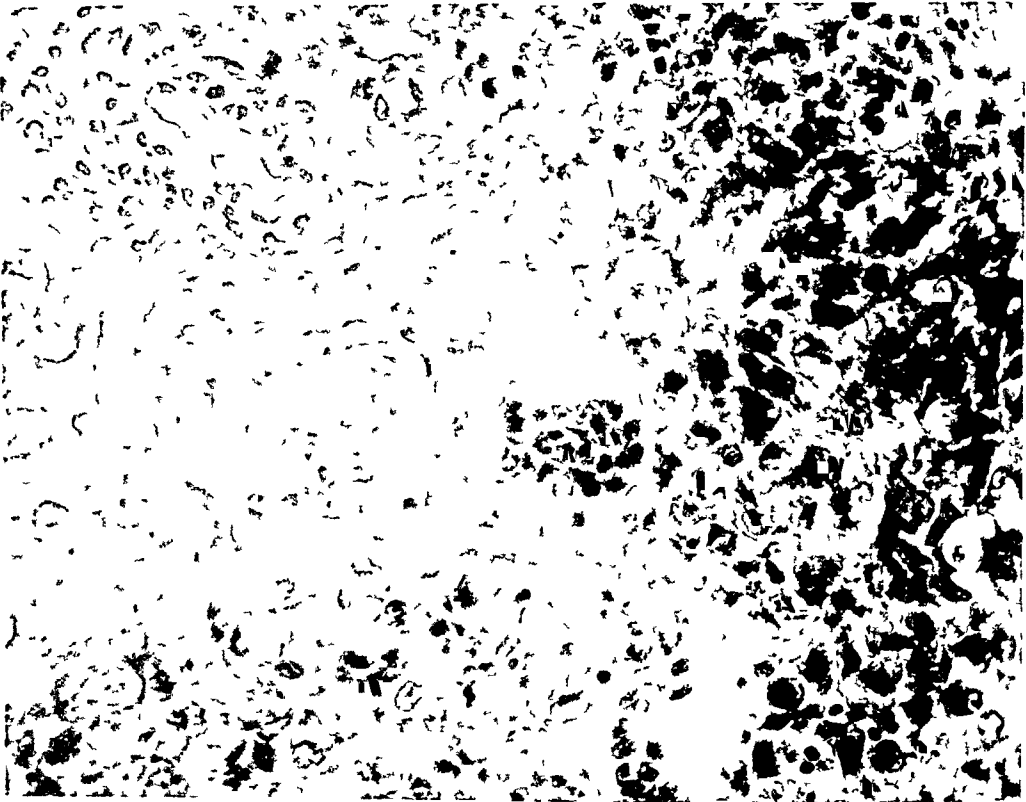


FIG. 32.—(Case No. 20 in text.) Central sarcoma of upper end of humerus, exploratory operation, toxins recovery, patient well 8 years later.

Wood believed it to be an osteosarcoma with giant cells, and Doctors MacCarty and Broder of the Mayo Clinic pronounced it a definitely malignant tumor.

This case forms the basis of a recent publication by Doctors William S. Stone and James Ewing, entitled *An Unusual Alteration in the Natural History of a Giant-cell Tumor of Bone* (*Archives of Surgery*, September, 1923, vol. vii, pp. 280-296). These authors take the position that the tumor in this case was originally a benign giant-cell sarcoma. They state:

"It is the object of this communication to review the history of our knowledge of the giant-cell tumor of bone, emphasizing its invariable failure to produce metastases, and to record a case in which this rule was broken in the case of a tumor which completely altered its original structural character and proved fatal, with pulmonary metastases, apparently as the result of repeated insults from

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attempted surgical removal, irradiation, and infection * * * The record of the case presented is of interest from several aspects. The transformation of the structure of a benign giant-cell tumor while evidently very rare and not previously recorded in this disease finds a parallel in similar transformations that have occurred in many other tumors, benign and malignant, after surgical and other forms of trauma.

"The development of metastases in this case proves no exception to the rule that the benign giant-cell tumor never produces metastases. Here, the metastasizing tumor was not a giant-cell tumor, but a malignant growth that developed out of

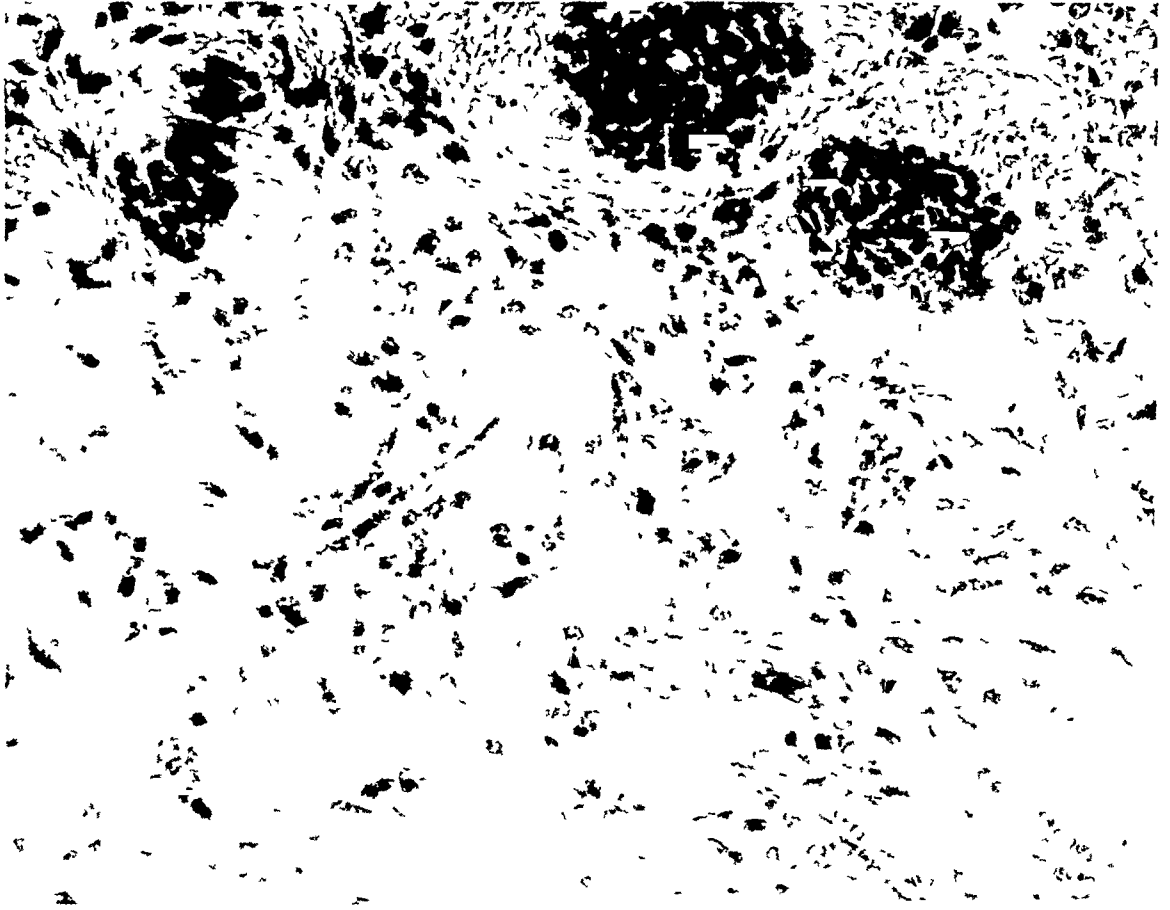


FIG 33 —(Case No. 21 in text) Central giant-cell sarcoma of tibia, curettage, toxins, recovery, patient well 8 years later

a giant-cell growth as the result of various insults, in which curettage and imperfect irradiation probably played the chief part."

I cannot agree with Stone and Ewing that here we had an original benign tumor which changed its original histological structure and ended in pulmonary metastases as a result of "repeated insults from surgical removal, radium, or infection." If it were a benign giant-cell sarcoma in the beginning, it should have been cured by the original curettage and carbolic acid, which, Bloodgood has long maintained, was the most approved and uniformly successful method of treatment of such cases. There was no infection in this case until eleven months after the primary operation, when a well-marked and rapidly growing recurrent tumor developed at the original

site On account of the severe hemorrhages and infection developing after a second curettage, I amputated the leg eight days later It seems to me more logical to believe that in this case we were dealing with an atypical variety of giant-cell sarcoma malignant from the beginning In support of this opinion, it is important to note that the original sections of the primary tumor were pronounced malignant by Doctors F C Wood of the Crocker Cancer Research Fund, MacCarty and Broder, of the Mayo Clinic Laboratory Bloodgood

has repeatedly shown that curettage does not increase the malignancy of these tumors and his statistics give support to his opinion Case III gives further support to this view inasmuch as the histological structure of the recurrent tumor was the same as the original tumor, "giant-cell sarcoma epulis type"

The practical conclusion reached by Stone and Ewing is, that, "The unfortunate outcome in this case suggests that the surgical plan of treatment if adopted in these cases, should be adhered to, and that it is unwise to attempt to combine surgical methods with post-operative radiation by means of radium inserted in the tumor cavity" While I agree with their view that the use of radium tubes inserted in the tumor cavity after curettage is unwise because it increases the chances of infection, I believe that post-operative radiation in the form of the radium pack or X-ray used a short time after curettage is often of great advantage,



FIG 34 —(Case No 22 in text) Giant-cell sarcoma of femur

and I have seen no ill effects from such use It seems to me that another and very important conclusion can be drawn from this case as well as from case No 3, immediately following and that is, that in both of these cases, early amputation as a primary measure in all probability would have saved the life of the patient, inasmuch as evidence of metastases did not occur for more than a year in one case and nearly a year and one-half later in the other case

It is clear from these widely divergent opinions that the surgeon is confronted with an almost hopeless problem, if he accepts the opinion of the pathologist that the tumor is benign, and treats the case accordingly, he

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may lose his patient later from metastases, on the other hand, if he amputates these cases as a routine measure he is condemned for his useless sacrifice of limbs. It will afford little satisfaction to the surgeon to find, after the patient has died of metastases, that the pathologist, on reviewing the histology of the original tumor, has changed his opinion and believes the tumor to be



FIG. 35 —(Case No. 1 in radius tables) View before treatment. Central sarcoma of radius probably giant cell, X-ray and clinical diagnosis.

either malignant from the start, or, a tumor that has become malignant on account of "insults" offered by the surgeon or radiologist.

In what way, then, must the surgeon meet this problem, and what course offers the best solution? I believe we will come nearer solving the problem by the closest cooperation between the surgeon, the pathologist, and the radiologist, and in the small group of cases in which there will be some doubt as to the diagnosis, after such cooperation, I believe the clinical evidence should out-weigh all other evidence in determining the method of treatment to be employed.

*CASE III—Benign Giant-cell Sarcoma of Tibia, Treated by Repeated curettage, and Prolonged Use of Radium, Disease Not Controlled, Amputation, Local Recurrence, Death from Metastases—*J. S., female, forty-four years of age, was admitted to the Memorial Hospital on March 15, 1921, with the following history: Pain in the tibia in May, 1920, admitted to the New York Hospital in October, 1920, on the service of Doctor Poole. A central tumor of the upper end of the

tibia was found and curettage was performed in the latter part of October, 1920, with implantation of fat

Microscopical examinations made by Doctor Elser, pathologist to the New York Hospital

"October 30, 1920 Specimen consists of a large quantity of irregular pieces of tissue, rather firm in consistence and homogenously yellow on cut surface Microscopical A frozen section presents the features of a giant-cell sarcoma"

'November 16, 1920 Specimen consists of several pieces of firm, white tissue more or less surrounded with blood clots Microscopical A section of one

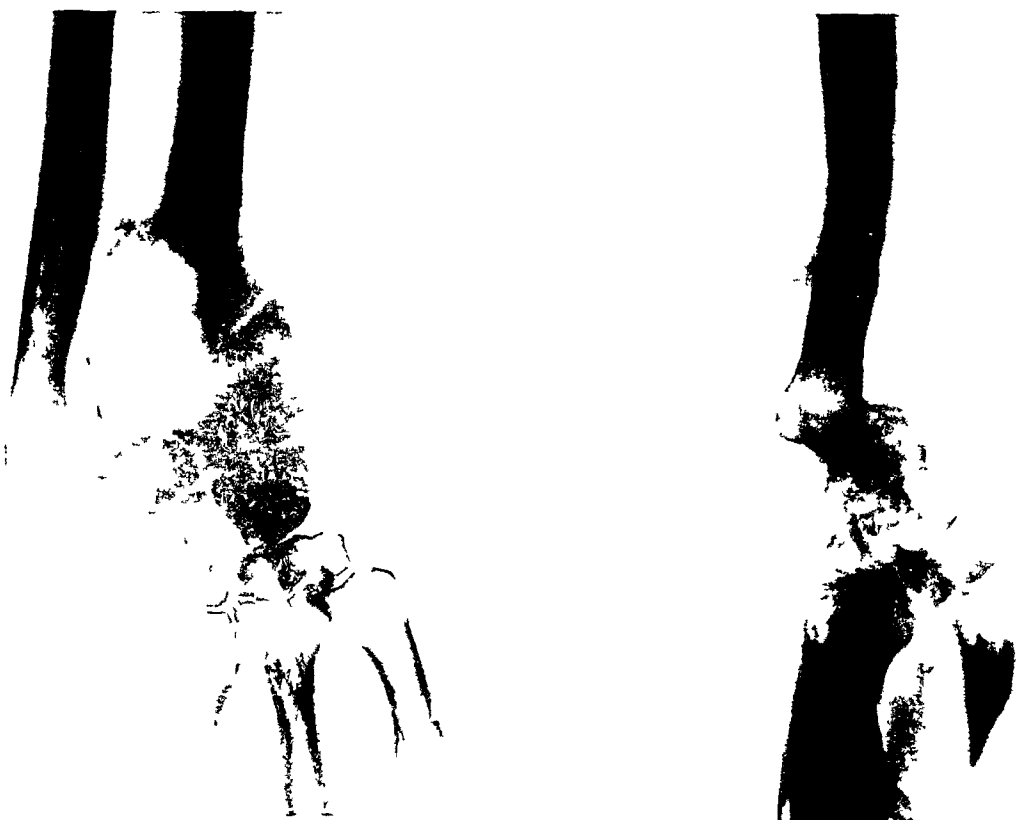


FIG 36 —(Case No 1 in radius tables) View two months later

of these pieces of tissue presents the features of a giant-cell sarcoma similar to the original growth A section of another piece is seen to consist chiefly of fibroblasts with irregular groups of medium-sized giant cells in this tissue"

'November 19 1920 The structure of this tumor suggests that it is not the usual type of central giant-cell sarcoma of bone The embryonal character of the unicellular elements, the abundance of mitotic figures some of which are atypical the excellence of nutritional condition (practical absence of necrosis and hemorrhages) differentiates this growth from the usual central giant-cell sarcoma The growth bears all the evidence of malignancy and the early recurrence is not surprising The case illustrates the fallacy of regarding all of these growths benign and curable by simple curettage Certain tumors of this class are not only locally malignant, but give rise, though rarely, to generalized metastases In this case the use of radium or X-ray is advised as against amputation of the limb Opportunity for dissemination has been given and if dissemination has occurred, all curative measures are futile If dissemination has not occurred the X-ray

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or radium is believed to be quite as effective as the knife. X-ray pictures of the lung should be made now, for comparison with others taken later at short intervals. Early appearance of new growths in the lung would indicate dissemination occurring during or before operative interference, and should not be charged to failure to amputate. If metastases occur late and the growth is not checked locally, the case would be a valuable lesson to X-ray and radium enthusiasts, and if metastases occur at all, it would be a valuable lesson to those claiming absolute benignity for this type of growth."

"November 23, 1920. Specimen consists of a white nodule, 1 cm in diameter,



FIG 37 — (Case No. 1 in radius tables) View nine months after treatment

covered with blood. Microscopical. A frozen section of the nodule presents the features of a giant-cell sarcoma, similar in its appearance to the sections previously made in this case.

Three other specimens were removed, and examined microscopically, Doctor Bancroft pronounced them

1. Fat transplant which had become necrotic
2. Necrosis (following radium)
3. Necrosis (following radium)

Other specimens were examined by Doctor Elser, who reported

"January 15, 1921. Specimen consists of an irregular piece of tissue about $\frac{1}{2}$ cm in diameter. Microscopical. Section shows the features of a giant-cell sarcoma. At one end of the section there is a slight amount of necrosis with fibrin and blood."

"January 18, 1921. Specimen consists of two small bits of soft tissue $\frac{1}{2}$ cm in diameter each. Microscopical. Both pieces present the features of a giant-cell sarcoma of bone, the cells being of the epulis type."

"March 11, 1921. Specimen consists of a piece of soft, red tissue about 1 cm in diameter and $\frac{1}{2}$ cm thick. Microscopical. Most of the tissue consists of fibrin, necrotic tissue, red blood cells, polymorphonuclears, and a few epulis type giant cells. A small piece of tissue consists of a giant-cell sarcoma, resembling the original tumor."

After the second operation performed by Doctor Poole, at the New York

Hospital, radium treatment was begun in November, 1920, by Doctor Stone, and continued at the Memorial Hospital from March 16 to August 5, 1921, as follows

March 16, 32 mc bare tubes in finger cots inserted in upper portion of sinus

March 20, 320 mc in silver tubes were placed in sinus

April 8, 4 areas were treated with radium pack Examination May 4, showed considerable improvement in condition

May 9, radium-pack treatment

May 18, radium needles, 24 mc were inserted for twenty-four hours

August 4, Bare tubes, 57 mc were inserted

The patient was discharged from the hospital on August 5, 1921 At this time, X-ray and clinical signs showed that the tumor was not under control Doctor Ewing's diagnosis in this case was "typical giant-cell sarcoma" Shortly after, she entered the Presbyterian Hospital, on the service of Doctor Auchincloss Her condition became worse, and an amputation was performed at the middle of the thigh on October 26, 1921 A microscopical examination was made by the pathologist of the Presbyterian Hospital, who reported "Giant-cell sarcoma of the epulis type" The disease recurred in the stump, and a few months later it extended into pelvis and spine, causing death November 5, 1922

This case with illustrations, will be published in detail by Doctor Bancroft in the near future While there was no evidence of lung metastases, the gradually increasing pallor, and cachexia, could not be accounted for by the tumor in the stump The X-ray picture of spine showed increasing lordosis and possible metastases in the lumbar region Doctor Auchincloss, in his summary of the case, describes the tumor as one which spread up the thigh into the pelvis and spine *

CASE IV—*Giant-cell Sarcoma of the Humerus*—M S C, female, forty-six years of age, was referred to me by Dr J H Reid of Troy, New York, on April 30, 1923, with the following history

In February, 1923, the patient fell down five steps, striking on her shoulder and remaining unconscious for several minutes Examination by Doctor Reid revealed a recent fracture of the juncture of the upper and middle third of the right humerus, transverse easily reduced He stated that, with the exception of considerable œdema of the whole arm and apparently more pain than usual, the six following weeks were uneventful, then he found good union in perfect position, but the pain was very intense Unfortunately, there was no X-ray picture taken at the time of the original accident, but eight weeks later, X-ray revealed what was apparently a malignant condition of the head and whole proximal fragment Wassermann negative

Physical examination, April 30, 1923, by Dr Bradley L Coley, showed the right upper extremity held in a sling, the elbow bent at an angle of 90°, the wrist flexed at an angle of 120°, fingers extended, œdema of the entire extremity, most marked on the dorsal surface of the hand Practically all motions at the shoulder, wrist and fingers were attended with great pain, there was, perhaps, five per cent motion of the elbow, flexion and extension, the same amount of flexion at the wrist, with no extension, the fingers were practically flexed Motion of all kinds at the shoulder was impossible There was no localized tumor and no dilatation of superficial veins The skin of the hand, besides being markedly œdematous, showed trophic disturbances

An exploratory operation was done by Dr Bradley L Coley on May 15, 1923 Microscopical examination by Doctor Jeffries giant-cell sarcoma, by Doctor

* I am greatly indebted to Doctors Pool and Bancroft for notes of the case while at the New York Hospital and to Doctor Auchincloss for the end-result noted at the Presbyterian Hospital

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Ewing benign giant-cell sarcoma of the epulis type, by Doctor Bloodgood benign giant-cell tumor

The tumor slowly increased in size accompanied by a great deal of pain. The patient was first seen by myself on June 3, 1923. In view of the pathological diagnosis of benign giant-cell sarcoma, it was decided to try conservative treatment. She was placed upon systemic injections of the mixed toxins of erysipelas and bacillus prodigiosus, which were pushed to the point of producing a reaction temperature of 103. During early July, the swelling diminished one inch in size, the patient was able to move her arm somewhat more freely, but the shoulder was kept immobilized by splints. In the middle of July, she was admitted to the Memorial Hospital, and given a massive dose of radium over the front, back and external part of the shoulder (12,000 mc hours at 10 cm distance). The patient returned home where the toxin-treatment was kept up by Doctor Reid.

An X-ray picture of the shoulder taken in September, showed an increase in the size of the tumor, examination of the lungs revealed no metastasis.

A picture taken in early November showed still further increase in the size of the tumor. Clinical

examination shows that the tumor has extended into the pectoral region, apparently infiltrating the muscles. A swelling developed at the lower end of the radius two weeks ago, which on X-ray examination, proved to be metastases. February 1, 1924, patient still living, no definite evidence of lung metastasis, but condition hopeless.

FIG 38 —(Case No 1 in radius tables) Well, May, 1923, five years

CASE V—Giant-cell Sarcoma of Femur, Amputation, Death from Metastases Three Years Later—E. R., female, sixteen years old, no trauma. The patient had a tumor of the lower third of the femur of three months' duration. Clinical diagnosis central sarcoma, malignant. Microscopical diagnosis giant-cell sarcoma. The toxins were given for one month before resorting to amputation, only slight improvement. Amputation was performed by Doctor Jeffries at the Hospital for Ruptured and Crippled, followed by 32 doses of toxins. The patient remained well for nearly three years, and then died of metastases in the pelvic bones, and probably in the lungs.

CASE VI—Giant-cell Sarcoma of the Upper End of the Tibia, Amputation Metastases in Radius and Lungs, Death—S., male, fourteen years old, patient of Doctor M. M. Lucid of Syracuse, New York. Tumor of two months' duration following an injury, amputation performed on August 7, 1913. The patient

remained well until October, 1914, or fourteen months later, when I examined him and found a typical central tumor of the left radius, no amputation was done, and in the early part of 1915, he developed typical metastatic sarcoma of the ribs and pleura, and died in July, 1915

CASE VII—*Giant- and Spindle-cell Sarcoma of Humerus*—R F, female, fourteen years old A shoulder-joint amputation was done at the Memorial Hospital on August 23 1911 The toxins were begun two weeks later and continued at home by Dr Louis I Mason, of Willimantic, Connecticut Only a few doses of toxins were given

Microscopical examination by Doctor Ewing giant- and spindle-cell sarcoma



of epulis type A local recurrence developed and increased rapidly in size, death occurred on October 28 1911, there were signs of septic absorption and probable metastases to lungs This case was undoubtedly a highly malignant osteogenic sarcoma and not the benign type, as shown by the clinical history and rapid return

CASE VIII—*Giant-cell Sarcoma of Humerus, Amputation, Death from Metastases*—C H, male, fourteen years old In 1913, a tumor occurred at the site of a recent fracture which had been united by

FIG 30—(Case No 10 in femur table) Central sarcoma Giant- and spindle-cell exploratory operation Toxins one year Decrease in size Rupture of popliteal artery Amputation 1912 Well ten years

Lane plates, the latter had been removed six weeks later, on account of infection A few weeks later, an exploratory operation was performed Microscopical diagnosis giant-cell sarcoma of mixed type One year later, the patient was referred to me by Doctors McGannon and Neil of Nashville, Tennessee, at this time examination showed extensive metastases in the femur, the hum, and probably, in the lungs Death occurred a few months later

CASE IX—(See case No 2 in Femur Table) Giant-cell sarcoma of lower end of femur, inoperable when first seen (1908) Exploratory operation was

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performed by Doctor Winters. Microscopical examination giant-cell sarcoma. The toxins were given for one month, with slight improvement, later, rapid increase in size, metastases developed in the iliac glands, and probably in the lungs, and the patient died two months later.

CASE X—*Giant-cell Central Sarcoma of Femur, Amputation, Metastases in Iliac Region and Lungs*—S S male, nineteen years, was presented at a conference of the Memorial Hospital staff on November 2, 1916, with



FIG 40—(Case No. 19 in femur tables)

FIG 41—(Case No. 19 in femur tables)

Benign giant-cell sarcoma of femur treated with X-ray, improvement, still under treatment

the following history: Local injury, kick, one year before, swelling two months later. Local operation performed at Bellevue Hospital about one month later. In October, 1915, amputation performed by Dr. John A. Hartwell. In September, 1916, or eleven months later, the patient noticed a swelling in the right iliac fossa, rapid increase in size. At the time of first observation at the Memorial Hospital (November 2, 1916), physical examination showed the whole iliac fossa and hypochondriac region occupied by a markedly protuberant tumor, firm in consistence, and apparently springing from the retroperitoneal glands. Examination revealed evidence of lung metastases, although there was no X-ray picture taken at this time.

Shortly after performing the amputation Doctor Hartwell showed this patient before the New York Surgical Society, and a full history of the case with complete

pathological data was published in the ANNALS OF SURGERY, 1916, pp 357-359 A microscopical examination was made by Doctor Symmers, who reported "Section throughout the tumor, involving the cortical layer of bone, showed neoplastic growth composed of several types of cells The most common variety was a large spindle-shaped, polygonal or round cell of abundant eosinophilic cytoplasm, and a round or oval nucleus which took the basophilic stain with varying degrees of

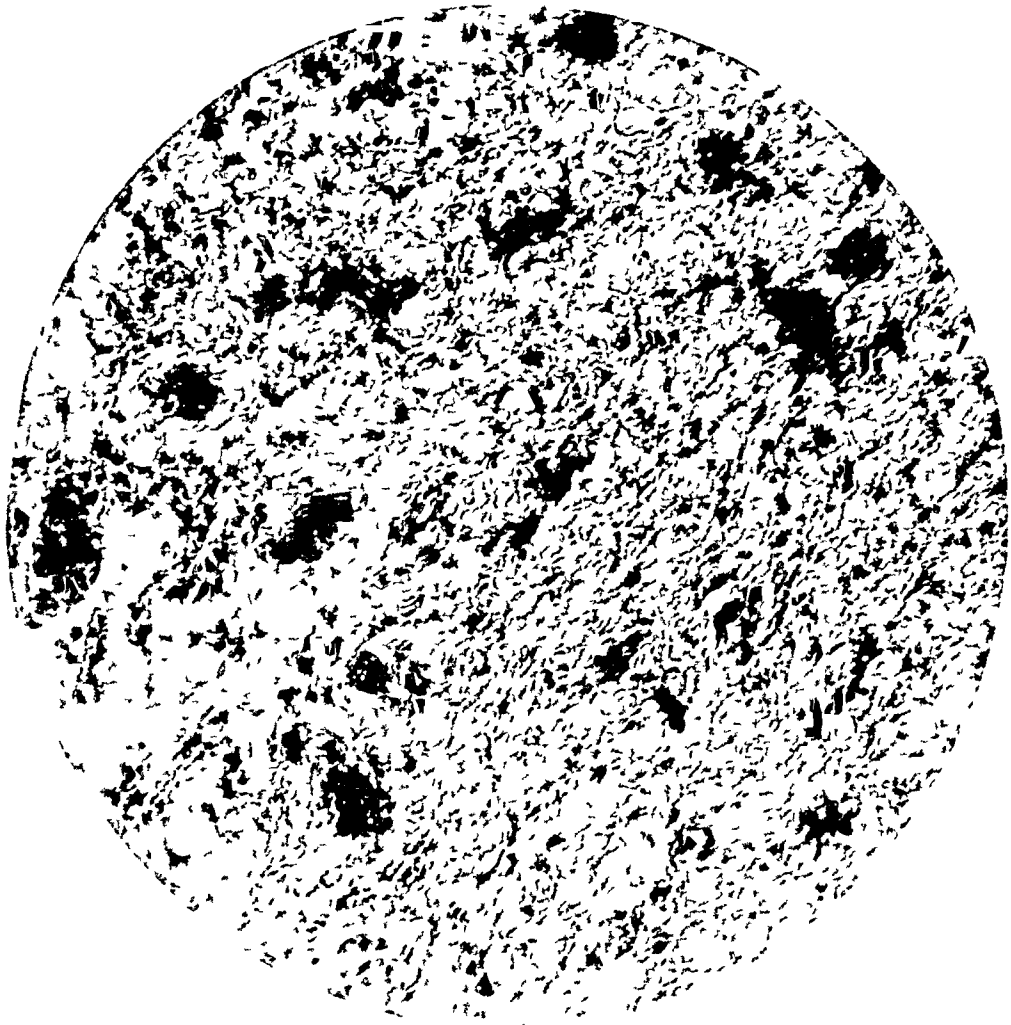


FIG 42 —(Case No 19 in femur tables)

intensity The cells lay closely packed together in a chaotic and irregular arrangement, and almost entirely filled the space between the bone trabeculae The picture was suggestive of a malignant sarcoma Besides the mononuclear cells were numerous giant cells which could be roughly divided into two main types Those in the central portion of the tumor showed numerous small nuclei oval in shape and varying in number from 15 to 40, grouped in the central portion of a huge, irregularly formed eosinophilic piece of protoplasm They were like the giant cells found in specimens of epulis The other giant cells were smaller, irregularly shaped contained huge round or deformed nuclei about 2 to 5 in number These

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were large in proportion to the amount of cytoplasm, and were sometimes arranged so as to form a horseshoe. These were the giant cells so often seen in malignant sarcomata. In this specimen they were found near the cortical portion of the bone, more than elsewhere, but contain only a few red cells. The blood-vessels are distended, and there are a few hemorrhagic areas. The connective tissue is scarce, and for the most part fibrillar. The bone, except in the central portion where

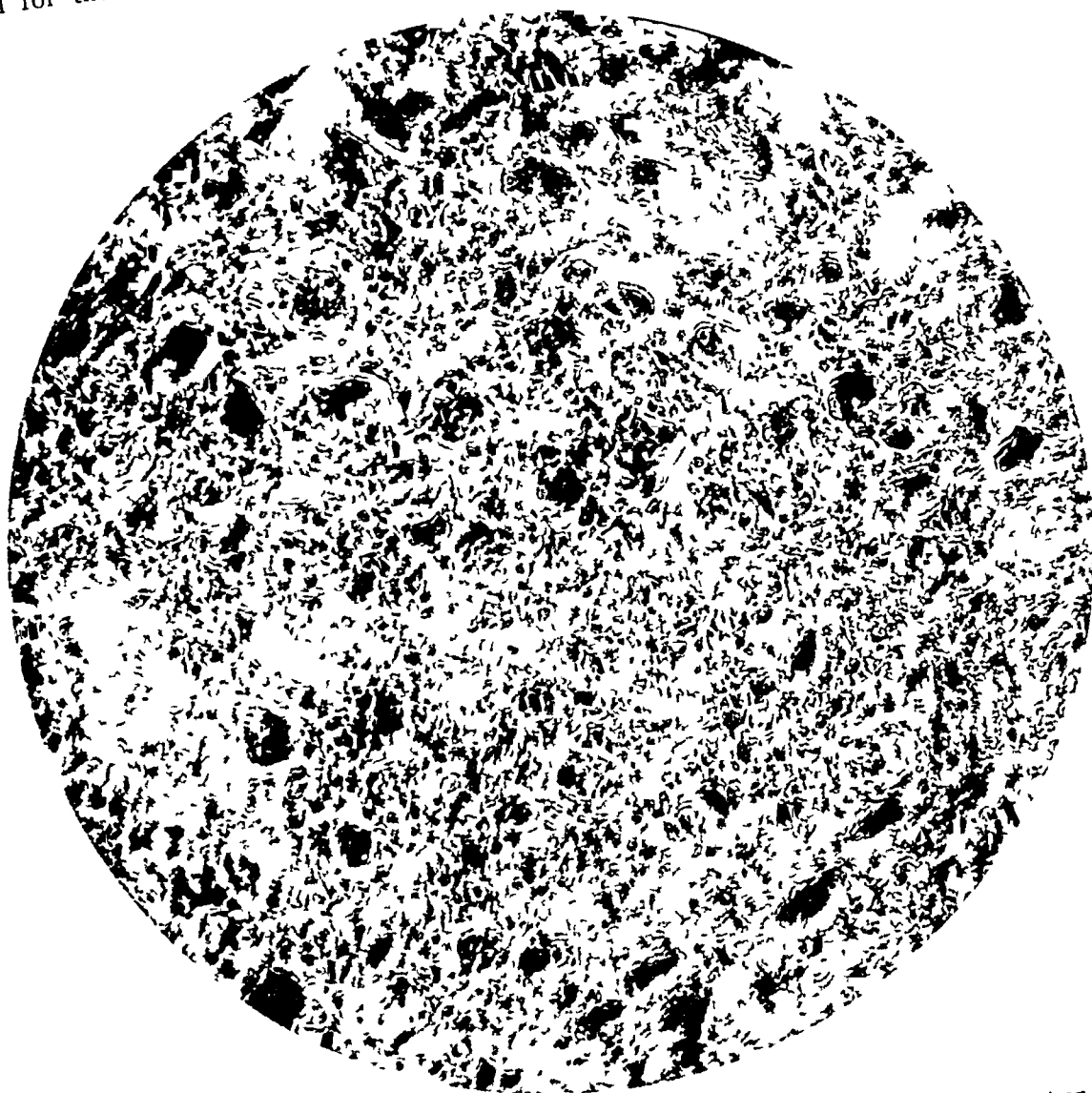


FIG 43 —Giant-cell sarcoma of femur. Epulis type. Recovery under simple curetting. Amputation advised and refused. Well two years later.

it is undergoing lysis by the tumor cells, is normal. "Diagnosis Giant-cell sarcoma of femur."

This case is reported not as an example of a typical benign giant-cell sarcoma causing death by metastases but as a case in which the two types of giant cells are found. If only one section were examined, it could easily be called benign giant-cell sarcoma.

CASE XI—*Giant-cell Sarcoma of Femur*. Amputation, Later Diagnosis; *Malignant Osteogenic Sarcoma*—Mrs. S., adult, first noticed pain in February, 1922, she was admitted to Bellevue Hospital for observation, for a period of eleven

days, no treatment. Several months later she went to the Flower Hospital where an exploratory operation was done, and a diagnosis of giant-cell sarcoma was made from a microscopical examination. She then received three radium treatments in the form of needles, and three X-ray treatments at another hospital. Six months later she entered the Hospital for Ruptured and Crippled where two casts were applied during a period of three to four months.

On March 10, 1923, she was admitted to the Memorial Hospital, at which time, physical examination showed a tumor occupying the lower six inches of the femur, apparently of central origin, there was marked swelling of the entire lower end of the femur and considerable loss of function. There was a radium burn over the outer aspect of the knee, and the patient was suffering intense pain.

X-ray diagnosis (Doctor Herendeen). Giant-cell sarcoma of distal end of femur. In March 12, 1923 it was decided to amputate on the ground that, while the tumor was probably of the giant-cell type, the patient was steadily growing worse, she was confined to bed, and even if the limb could be saved by X-ray or radium, it would be of little use, and there was no certainty that the pain could be controlled, amputation was accordingly performed.

Gross examination of the amputated specimen showed a tumor occupying the lower end of the femur, beginning about 7 cm from the lower end, at which point, there begun abruptly complete destruction of the bone. The tumor is globular in shape and has a circumference of 11 cm. There are a few cystic areas containing a small amount of serous fluid. Although it extends down to the articular surface, it does not invade the joint except at one place. Neither periosteum, cortex or medullary are affected beyond the point where the tumor tissue probably ends. The contour corresponds to a giant-cell tumor of the benign type. In addition, there was a small nodule in the soft tissues about 2 cm from the main tumor.

Three portions of the tumor were subjected to microscopical examination, *i.e.*, from the soft parts, from the periphery, and from the central portion. Microscopical examination of all three specimens showed the tumor to be a highly malignant spindle-cell sarcoma and not a giant-cell tumor. The patient made a good recovery, and is now wearing an artificial limb seven months after the operation.

This case is of special interest as it again emphasizes the difficulty of making a diagnosis of giant-cell sarcoma from the clinical and X-ray findings alone even when supplemented by microscopical examination of a small specimen removed at exploratory operation.

CASE XII—*Benign Giant-cell Sarcoma of the Radius*—F, female, forty years of age, was admitted to the Hospital for Ruptured and Crippled on November 28, 1919, with a tumor of four months' duration. A microscopical examination was made by Doctor Jeffries, who reported giant-cell sarcoma, this was later confirmed by Doctor Ewing who pronounced it a giant-cell sarcoma. The tumor was a very small endosteal one, and seemed to be a good case in which to test the value of Bloodgood's method of treatment, that is, curettage and carbolic acid, accordingly no other treatment was employed. Six weeks later, the tumor had recurred and was growing rapidly in size. The patient was put upon systemic injections of the mixed toxins, at the end of six weeks' treatment, the tumor had practically disappeared, and the toxins were discontinued. Three months later, the disease had recurred and was increasing rather rapidly. She was then put upon radium-treatment alone, which was kept

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up for four months, a total of 90,000 mc hours being given. During the treatment there was steady increase in size of the tumor, with no new bone production, the disease now extended 3 inches above the lower end of the radius. An amputation was considered unavoidable, but before resorting to it, it was decided to give her another trial of toxin-treatment. The radium-treatment was discontinued, and the toxins were resumed in October, 1920, and continued for four months. Immediate and steady improvement was noticed, with gradual regeneration of new bone filling up the area that had been destroyed by the tumor. She received no further treatment after February 1921. A recent examination shows the lower end of the radius to be in excellent condition, there is complete restoration of function, and the patient is in good general condition, four years since the beginning of treatment.

The most striking cure of giant-cell sarcoma that has come under my observation, was a case of sarcoma of the spine and not of the long bones. This case is published in full in my paper in the Transactions of the Third International Congress for Cancer Research, Brussels, 1913.

The following is a brief abstract.

Male, age twenty. Always well until latter part of 1901, when he developed a swelling in mid-dorsal region. The tumor grew rapidly, partial paralysis of the lower extremities began a short time later and he was sent to the Montefiore Home for Incurables. I saw him at this institution in consultation with Dr. V. P. Gibney in February, 1902. At this time he had a very large tumor, occupying at least five or six of the dorsal vertebræ. He had complete paralysis of the bladder and rectum and lower extremities and had lost fifty pounds in weight, and his condition seemed absolutely hopeless. He was put upon the toxins of erysipelas and *B. prodigiosus* without any other treatment. The treatment was kept up four months with severe reactions. Improvement was immediate and striking. He was able to walk with plaster cast in September. He made a complete recovery and married not many years later, has two children, and is well more than twenty years. Microscopic examination was made at Bellevue Hospital Laboratory. It was pronounced by Dr. Harlow Brooks as round-cell sarcoma and had many giant-cells.

The following four cases while classed as giant-cell sarcoma were all clinically malignant, furthermore, on microscopical examination, three were pronounced malignant by the Mayo Clinic Laboratory, two by Doctor Wood, and three by Doctor Barrie, also, in the first and second cases of this group, at the time of the original exploratory operation, Doctor Ewing said that he did not regard them as belonging to the benign group. In the third case, the tumor had broken through the bony shell and had invaded the soft parts, and in the first three, the knee-joint was extensively involved. In three of the four cases, amputation had been strongly advised by a number of surgeons (in two cases, by myself). The limb was saved in three of these cases, and in the fourth case, the tumor which had apparently disappeared, recurred at the end of six months, necessitating amputation.

CASE XIII—*Sarcoma of the Lower End of Femur*—(For full report see ANNALS OF SURGERY, December, 1919)—L. G., female, twenty-one years of age,

with a tumor of the lower end of the femur, with extensive involvement of the knee-joint. Amputation had been advised but refused. A small section was removed for microscopical examination, no curettage.

Pathological report by Doctor Ewing: "The mass consists of several broken portions of tumor tissue, each about 1 cm. in diameter.

"On section the masses are composed of dense fibrous tissue, in many places hyaline, covered with a fringe of sarcomatous tissue of the type of giant-cell sarcoma. The giant cells are of the epulis type. There are a few trabeculae of bone which are separated by spindle tumor cells and are undergoing absorption. In several places the dense fibrous tissue is infiltrated by strands of tumor tissue in which the cells are spindle in form, with slightly hyperchromatic nuclei, but without admixture of giant cells.

"In the absence of full data regarding the anatomy of the tumor and its clinical course, it is impossible to give any positive opinion of the clinical malignancy of the case. The giant-cell areas belong in a group which generally pursues a benign course. The spindle-cell areas seem to possess greater growth capacity."

Doctor Ewing, later reporting on the case, stated: "The tumor was not histologically benign, I merely mean it was not extremely malignant."

The patient was put upon prolonged toxin-treatment which was kept up for nearly a year. Immediate improvement was noticed which continued until complete recovery had taken place. She is still well nine years later, and has a useful limb, with two inches' shortening.

Another case, almost identical, is

CASE XIV—*Sarcoma of the Lower End of the Femur and Upper End of the Tibia*—(For full report see ANNALS OF SURGERY, December, 1919)—C. S., female, twenty-nine years of age, was admitted to the Memorial Hospital on November 10, 1916. Amputation had been advised by every surgeon who saw the case, including myself, but the patient refused. I did an extensive curettage, keeping the cavity clean with Dakin's fluid. The patient was then put upon the toxins for about three months, followed by one radium-pack treatment and a steel needle of radium (100 mc.) introduced for three hours. The patient made a complete recovery, with complete restoration of function; there is practically no shortening and she walks with scarcely a limp. It is now seven years since the treatment was begun. She is in good health, January, 1924.

A microscopical examination was made by Doctor Ewing, who reported:

"The tumor has the general features of a giant-cell medullary sarcoma. Several areas are unusually cellular, which indicates a guarded prognosis."

In order to verify the diagnosis, Doctor Ewing made a further examination, and reported:

"While the tumor shows certain areas of typical giant cells, there are other areas in which the giant cells are comparatively few in number and bunches of spindle and round cells are present."

CASE XV—C. F., female, seventeen years—Central sarcoma of the upper end of the Tibia mixed-giant- and spindle-cell. (For full report see ANNALS OF SURGERY, December, 1910.) Admitted to the Hospital for Ruptured and Crippled in August, 1915. Disease pronounced giant-cell sarcoma of the epulis type, very moderate degree of malignancy by Ewing, malignant by Barrie and McCarty. Curetting followed by toxins, 7 months later toxins discontinued on account of attack of grippe. recurrence of tumor, second curetting, recurrence,

PROGNOSIS IN GIANT-CELL SARCOMA

again treated with toxins and one application of radium (pack) Complete recovery with useful limb, well at present eight years later

CASE XVI—*Giant-cell Sarcoma of the Upper End of the Tibia with Involvement of the Entire Knee-joint*—M. C., female, twenty-three years of age, was admitted to the Hospital for Ruptured and Crippled on December 5, 1920

Previous history In July, 1920, the patient fell on a hard floor, injuring her knee, two or three days later severe pain set in, and a short while after, a swelling developed She remained in bed for two weeks, the pain increasing in severity She consulted Dr. J. H. T. Sweet of Hartford, Connecticut, who, at first regarded the condition as tuberculosis and applied a plaster cast, but on further clinical and X-ray examination, Doctor Sweet believed the condition to be sarcoma On December 7, 1920, she was referred to me by Doctor Burlingame of Cheney Brothers (where the patient was employed) Physical examination at this time showed complete destruction of the upper end of the tibia, with involvement of the entire knee-joint, there was marked enlargement of the upper end of the tibia extending down about $4\frac{1}{2}$ inches Clinical and X-ray diagnosis central sarcoma, malignant Extensive curetting was performed under ether followed by a prolonged course of toxin treatment The wound was kept clean with Dakin's solution The operation showed a tumor the size of an orange, occupying the upper end of the tibia, which completely destroyed the cartilage of the knee but which did not involve the femur The joint was disorganized and filled with fibrous broken-down tissue, the tumor was partly cystic, the solid portions of which, were of a reddish color The cavity was swabbed out with carbolic acid and packed with sterile gauze, and the limb was put up in a plaster splint After receiving thirty-nine injections of the mixed toxins at the hospital, the patient returned home, where the injections were continued for two months, no other treatment was given The cavity filled up with normal granulations and the sinus healed within three months Microscopical examination

(1) By Doctor Jeffries —“Giant-cell sarcoma The tissues exhibit a considerable degree of necrosis”

(2) By Doctor Ewing —“Giant-cell sarcoma, epulis type”

(3) By Doctor George Barrie —“Definitely malignant tumor, fibro-sarcoma”

Clinically the tumor was malignant in view of the rapid growth and destruction of the whole upper end of the tibia with involvement of the knee-joint The patient did well for about eight months, and then the disease recurred locally Infection of the wound set in, which was greatly aggravated by one application of radium, and immediate amputation had to be performed The patient made a good recovery, and is well at the present time, two years after the amputation

An interesting result in a case of tumor of bone other than a long bone was published in an earlier paper (Transactions of the Third International Conference of Cancer Research, Brussels, 1913), and will be mentioned briefly here

CASE XVII—*Giant-cell Sarcoma of the Ilium*—Mrs. F., thirty years of age Patient fell on the ice in 1908, receiving a severe blow on the buttock and ilium A tumor developed two months later First operation performed by Dr. Andrew J. McCosh at the Presbyterian Hospital Microscopical examination by the pathologist of the Presbyterian Hospital showed the tumor to be a giant-cell sarcoma X-ray treatment was given shortly after operation The tumor recurred

and became inoperable. Radium treatment was begun in June, 1909, by Doctor Abbe, of New York, and continued by Doctor Wickham, of Paris. During 1910, she received several very large doses of radium, without controlling the growth. The patient was referred to me by Dr Frank Hartley, in May, 1911, at which time she was markedly anæmic and considerably emaciated suffering from intense pain. Physical examination showed a large inoperable tumor of the ilium. Under four months' toxin-treatment, the tumor became very much smaller and broken

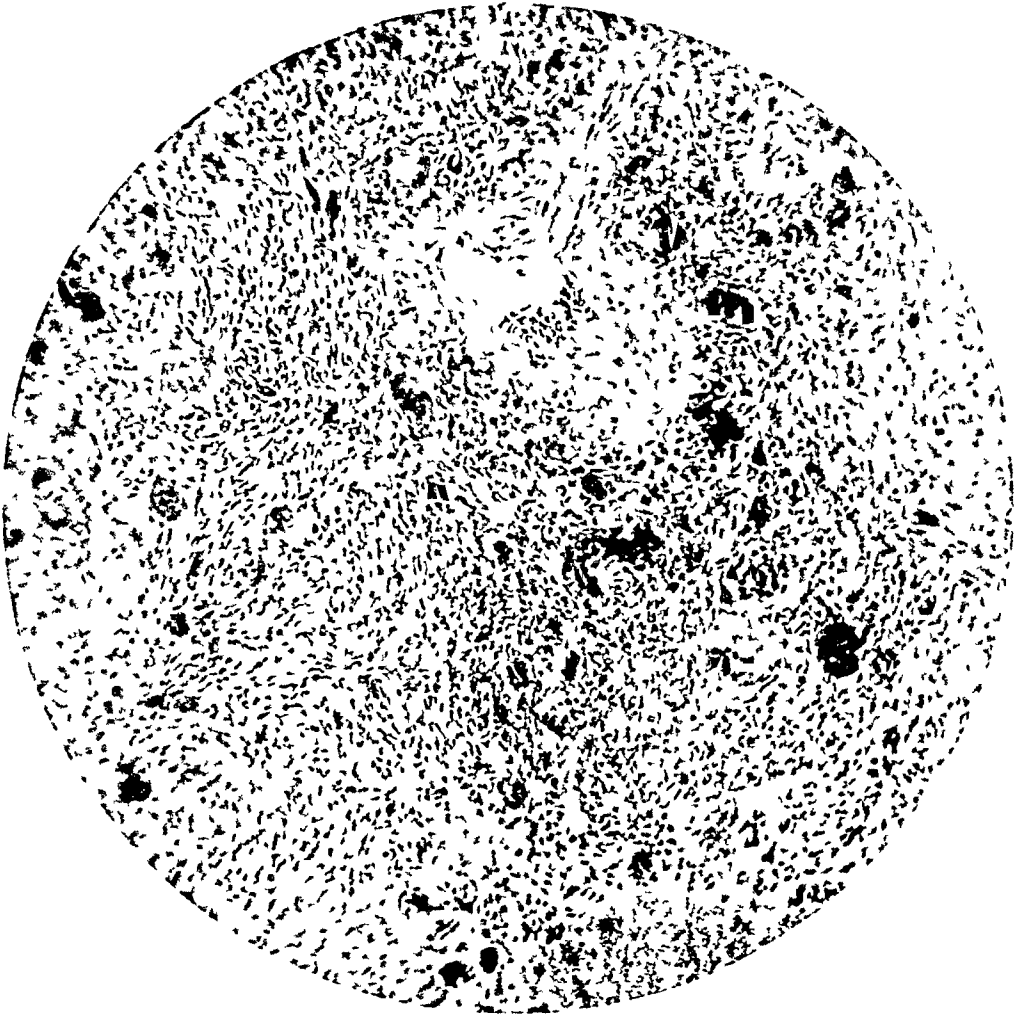


FIG 44—Epulis type recurrent after operation. Not controlled by either toxins or radium. Disease progressing when left hospital patient not traced.

down making it advisable to do a curettage. A microscopical examination was made by Doctor Ewing, who reported:

"The tumor diagnosed as giant-cell sarcoma, proves in my sections of the material to be as supposed, a giant-cell sarcoma. It is composed chiefly of small spindle cells in which lie many giant cells of the epulis type. There are numerous areas of hemorrhage, and the giant cells are most numerous in these areas. The structure is that of a tumor of moderate malignancy. Its position may render it more serious than if it were in a superficial position, but histologically it is not to be classed with the more malignant or periosteal growths."

The patient apparently, made a complete recovery and remained well for five

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years, when the disease returned, and she died the following year of symptoms of probable metastases

Although giant-cell sarcomata of the jaw are usually regarded as benign, I have observed two cases in which the disease progressed with great rapidity and caused death within less than six months. There was no positive evidence of metastases in either case. The microscopic diagnosis was giant-cell

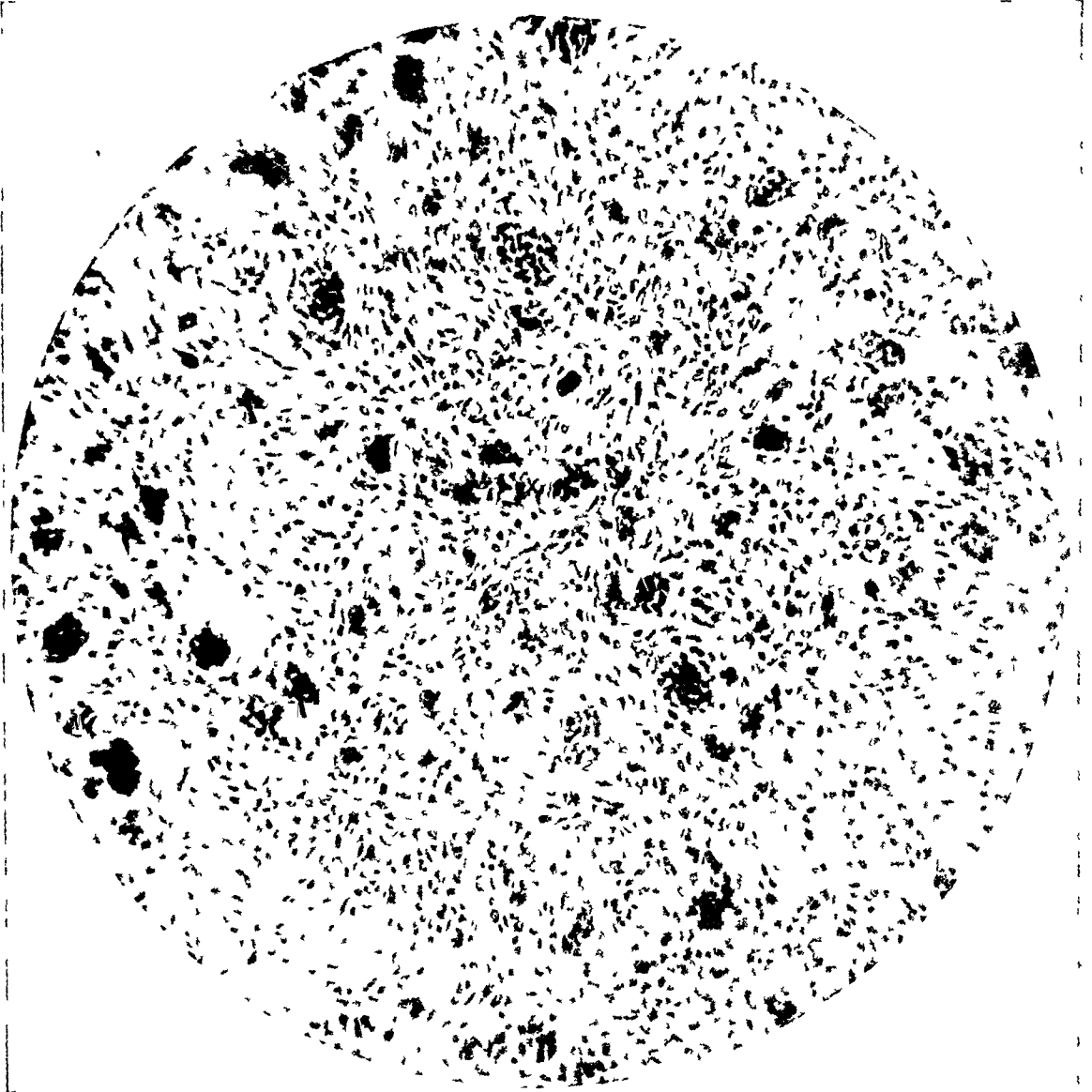


FIG 45 —Giant-cell sarcoma epulis type. Specimen removed from metastatic tumor of ilium six months after removal of primary tumor of jaw

sarcoma of the epulis type, in both cases. In one case the diagnosis was made by Doctor Ewing.

The following case was seen by me in consultation with Doctor H. H. M. Lyle, who has kindly given me permission to report it.

CASE XVIII —*Giant-cell Sarcoma of Lower End of Right Femur* —M. O., male, thirty-four years old, was admitted to St. Luke's Hospital on April 8, 1921. Seven months before, the patient had been struck on the outer side of the right knee, by a heavy weight, immediately after which, the knee became swollen and

extremely tender The swelling subsided in two weeks, but the pain continued and remained unvaried in character since the onset, there were no signs of inflammatory trouble present

Physical examination showed a well-developed, well-nourished man of thirty-four years General physical examination negative

Clinical diagnosis Bone cyst of femur, or giant-cell sarcoma

Rontgen examination showed an area of diminished density in the lower end of the right femur extending from the articular surface of the external condyle up for a distance of 6 cm There were lines of density equal to the bone dividing the rarefield areas into sections giving the appearance of osteitis fibrosa cystica The process extended from the anterior to the posterior surface of the bone Lungs were free

Pre-operative diagnosis Bone cyst of femur

Post-operative diagnosis Bone cyst of femur, question of osteosarcoma

Operation, April 13, 1921 Incision, curettage, and carbolic acid

Pathological report "The external condyle of the femur was hollowed out by a large cavity $1\frac{1}{2}$ inches or over in its transverse direction, and one inch from front to back The wall externally, was of paper-like thinness and anteriorly was also quite thin The cavity contained a considerable amount of grayish-yellow material mixed with blood, the bone covering very soft"

Microscopical examination "Sections of the soft parts show that they are composed almost exclusively of a dense fibrous stroma in which many fairly regular giant cells of the epulis type are thickly distributed The nuclei of these cells are comparatively regular and their morphology is that of one of the more benign types of myeloid sarcoma The stroma, although very cellular is composed of nuclei also fairly regular, but mitoses are not infrequent It cannot be considered a benign tumor, although it probably has arisen in the myeloid cavity The older portions of the stroma are less cellular There is no cartilage, but very early osteoid areas may be found" St Luke's Hospital Laboratory, Doctor F C Wood and Doctor Knox

Second operation, May 11, 1921 Incision, curettage, muscle transplant

Pre-operative diagnosis Giant-cell sarcoma of femur

Post-operative diagnosis Giant-cell sarcoma of femur

Microscopical examination "Sections show considerable solid cellular tissue of the spindle-cell type, in some of which giant cells are rare In other areas they are more frequent, but tend to be small and only have a limited number of nuclei The cells of the stroma are rather short and rounded, vary considerably in their nuclear chromatin, and mitoses are frequent Parts of the tumor are hemorrhagic and show old blood pigment There are a few bony trabeculae evidently from the normal bone although a few of them may be newly formed There is not, however, much tendency toward differentiation On the whole, the section resembles an earlier one but the giant-cells are somewhat less frequent"

Rontgen examination August 4 showed an area of rarefaction in the lower end of the femur

Rontgen examination September 3, showed the rarefied area considerably decreased, and the process, apparently, not active at the present time

Examination in the beginning of October, 1923, showed the patient well and in good condition two and one-half years later

The following three cases while not personally observed, have been of great interest to me ever since they were published in the *Journal of the Michigan State Medical Society* (October, 1916) by Doctor Harold deB Barss Through the courtesy of Doctor Barss, I have been able to keep a

PROGNOSIS IN GIANT-CELL SARCOMA

careful follow-up record of these cases, and through the kindness of Doctor Waitlin, Pathologist, Surgical Clinic University of Michigan, I have just been supplied with microscopic slides and micro-photographs of the cases. The fact that they are all well at the present time is of special interest and justifies us in briefly reporting the cases here.

CASE XIX—*Myelogenous Giant-cell Sarcoma of the Lower End of the Femur, Curettage, Toxins, Recurrence in Four Months, Amputation, Recovery, Patient Well over Eight Years Later—*

M. G., female, eighteen years of age, was admitted to the University Hospital in August, 1915. Symptoms: pain and swelling of lower end of femur, previous local trauma. Duration: six months. X-ray report: "There is an almost exactly spherical shadow about the size of an orange on the lateral aspect of the knee, central, just over the external condyle. It has produced a calcification and absorption of the shaft for about one-half its diameter. The external condyle is almost completely decalcified. There is almost no tissue reaction, a mere suggestion of calcification along one edge. Diagnosis: Evidently some neoplasm, presumably sarcoma."

Exploratory operation, with curetting. Microscopical diagnosis: "Giant-cell, spindle-cell myelogenous sarcoma. Much necrosis." The mixed toxins of erysipelas and bacillus prodigiosus were begun two days later, a second course was begun one month later, the last injection was given on January 15, 1916. In the middle of January, 1916, a local recurrence developed, rapid growth, hip-joint amputation was performed, microscopical diagnosis, myelogenous giant-cell sarcoma. Microscopical examination of limb after operation showed that the tumor had extended to the surface of the cartilage covering the external condyle of the femur. It had infiltrated the soft parts

along the external ligament to the head of the fibula. Of the lower end of the femur internal to the tumor there was but a thin shell of bone which was easily crushed. The tumor extended posteriorly into the soft parts to within one-quarter inch of the popliteal vessels.

The patient made a good recovery. A letter from her family physician on October 13, 1923, states "M. G. is enjoying good health, no symptoms of any return of her former malady, physically and mentally she is normal."



FIG 46—Clinical and X-ray diagnosis was giant-cell sarcoma, exploratory operation and curettage, microscopical diagnosis, malignant central sarcoma. Operation by Dr. Lilienthal in March 1922. Curettage and fat implantation followed by toxin treatment.

Doctor Warthin on reviewing the microscopic slide, states "This is a relatively benign type of bone sarcoma, practically no danger of metastasis. Local excision advised by pathologist but because of large size of neoplasm and the amount of bone replaced, hip-joint amputation was performed."

Microscopical Report (Doctor Ewing, December 18, 1923)

"Giant-cell tumor atypical. In places on outer edges, stroma is very cellular. Cells are large spindle, round, or polyhedral. Hyperchromatism slight. Probably benign but prognosis doubtful. Likely to recur after incomplete curettage."



FIG. 47.—Same case two years later, no evidence of return of the disease.

CASE XX—*Central Sarcoma of the Upper End of the Humerus, Exploratory Operation Followed by Toxins, Complete Recovery, Patient Well Eight Years and Eight Months Later*—A W, male fifteen years of age, was admitted to the University Hospital in January, 1915, with a tumor of the right shoulder, inability to raise arm, pain in right shoulder for eight months, no history of injury.

Radiographic report "On the external anterior surface of the head of the humerus involving both the epiphysis and the diaphysis, there is an irregular area of absorption with localized areas of calcification on both in the centre and the periphery extending well out toward the integument. The head of the bone is considerably enlarged with practically no wasting of the shaft of the humerus distal to the pathology. Diagnosis Sarcoma of the head

of the humerus." Exploratory operation, microscopic diagnosis "Myelogenous sarcoma, great numbers of enormous giant cells in a matrix of large round epithelioid cells, probably of endothelioid origin, prognosis not very good, should be searched carefully for metastases." The mixed toxins were begun three days after the operation. The patient was discharged from the hospital in March, 1915, and the toxins were continued at home. Report January 15, 1916, wound healed, patient in good health and getting use of arm, no pain.

A letter from the family physician on October 12, 1923, states

"Patient is a fine young giant, works in grist mill, lifting heavy bags, etc., could not be better."

Doctor Warthin, on reviewing the microscopic slide of this case, states

"This is a relatively benign type of bone sarcoma but in our experience, more malignant in the scapula than in the long bones. We have seen two cases of this neoplasm primary in the scapula with metastasis."

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Microscopical Report (Doctor Ewing, December 18, 1923)

"This appears to be one of the cases of giant-cell tumor associated with the absorption of cartilage. Such tumors are generally found at the head of the humerus. The giant cells are rather numerous, typical epulis type, and most numerous about blood spaces. The accompanying cells are peculiar, and are rather large polyhedral granular cells occurring in sheets, and clumps. In some areas the giant cells are missing and the polyhedral cells appear exclusively. There are several small foci in which there is dark staining fibrillar or partly hyaline material, which appears to be degenerating cartilage. There may be some new formation of this imperfect cartilage. There is no sign of bone formation. It does not resemble any of the well-known forms of osteogenic sarcoma. Tumor is relatively benign, but probably more active than most giant-cell tumors."

CASE XXI—*Central Giant-cell Sarcoma of the Tibia, Curettage Followed by Toxins, Recovery, Well Eight Years Later*—T. F., female seventeen years of age, was admitted to the Surgical Clinic on March 1, 1915. Symptoms: pain and swelling in right knee and inability to use the limb for about five months. X-ray report: "The head of the tibia is the seat of a rather absorbing process which has resulted in the loss of all details of the external portion. The joint surface is spared. There is some swelling. No periosteal reaction, no abnormal calcification. The cortex has entirely disappeared both front and back. Evidently and infiltrative growth within the bone. Diagnosis: sarcoma."

Exploratory operation on March 4, 1915, pathological diagnosis: "giant-cell myelogenous sarcoma." The patient was immediately put upon the toxins, the maximum dose being nineteen minims. Rapid improvement took place, as well as gain in weight, and disappearance of pain. A second course of treatment was begun on April 28, 1915, and a third course on August 18, 1915. Examination on November 5, 1915, showed the patient in excellent condition, and the wound practically healed. In February, 1916, a small soft area appeared in the centre of the former incision. Another course of toxins was begun. By April 26, 1916, the wound had entirely healed, and the suspicious area had increased in size. Radiographic picture confirmed fears, the thin sclerosing margin of the surgical defect had almost disappeared, the cortex on the internal surface had reduced considerably, diagnosis, recurrent sarcoma of head of tibia. The patient was advised to continue toxin-treatment.

While this is the latest note found in the published record of the case, a letter from the family physician on December 4, 1920, states:

"This patient, as far as can be observed, is in perfect physical condition. The upper shaft of the tibia, where the osteo-sarcoma, or medullary sarcoma was located, being in healthy and normal condition, never having recurred or given her trouble since recovering from same (this dating from the time she was in your clinic)." Under date of October 13, 1923, the family physician again wrote: "Patient is in fine health, and the end results of operation and treatment are fine, there is no return or any effects left."

Microscopical Report (Doctor Ewing, December 18, 1923)

"Giant-cell tumor, typical benign"

Through the kindness of Dr. W. Edward Gallie, of Toronto, Canada, I am permitted to give a brief history of a case of giant-cell sarcoma of the femur which he recently showed before the Interurban Surgical Society in Toronto. This case is of particular interest, as it is one of the few giant-cell femur cases that have been cured by curettage.

CASE XXII—Male adult, history of repeated trauma in 1914, in 1920, fell on the ice, causing a severe sprain of knee, he was laid up in bed for two weeks.

with swelling and soreness, the latter continued, but the severe pain disappeared after one year. Examination on March 17, 1922 showed patient walking with a slight limp, left knee-joint apparently normal, slight thickening of lower end of femur, deep tenderness on inner side. X-ray diagnosis: Giant-cell tumor.

Operation by Doctor Gallie on April 12, 1922, who made a window in the outer side of the external condyle about $2\frac{1}{2}$ inches long and 1 inch wide, cortex was only $\frac{1}{8}$ inch thick. A large cavity was found containing hemorrhagic and yellow

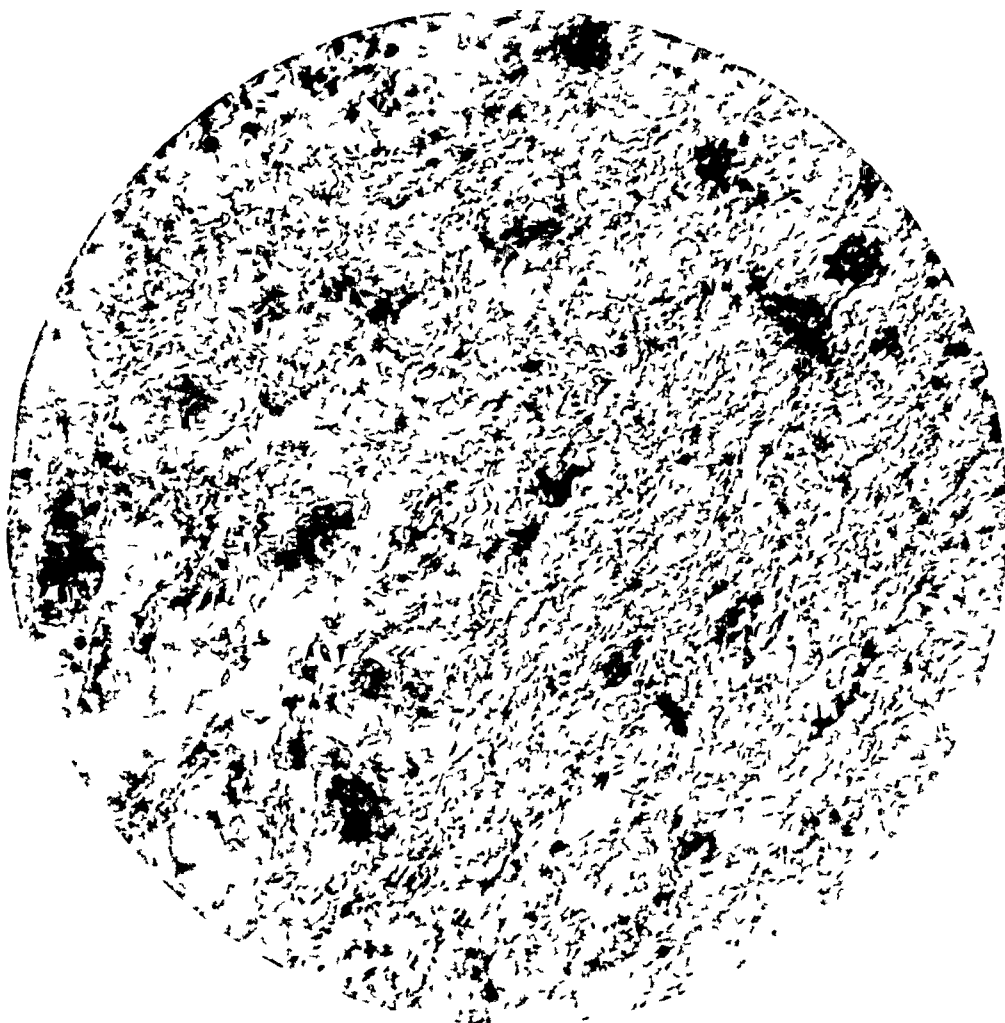


FIG. 48—(Case No. 19 in femur table.)

tumor mass of a very crumbly nature, in which were many small bony particles. The tissue resembled a mass of fish eggs. The cavity was thoroughly curetted, and filled with pure carbolic acid which was left in for about three or four minutes, after which it was aspirated and filled with pure alcohol. The periosteum was closed over a window. The patient made a good recovery and was still well when last observed one year and eight months later.

As to the pathological examination, Doctor Gallie states: "The tissue was submitted to the pathologists here and the diagnosis of giant-cell tumor confirmed. A section was also sent to Doctor Codman and the diagnosis

PROGNOSIS IN GIANT-CELL SARCOMA

confirmed by him. There is just one point about it which does not agree with Doctor Ewing's description of benign giant-cell tumor. It seems to be filled with small spiculæ of bone, which are evidently alive, and I think must be interpreted as evidence of bone proliferation. Doctor Ewing says that these benign giant-cell tumors should not contain new bone."

CONCLUSIONS

In view of the cases here reported, it would seem necessary to modify the opinion so strongly held by most of the leading pathologists of to-day, that giant-cell sarcoma is *always* benign and never gives rise to metastases. As far as the author can see, there is only one explanation of these cases which still leaves it possible for one to entertain the theory that giant-cell tumors are always benign, and that is, to assume that all of the cases here reported, in which metastases developed ending in death, were cases of mistaken diagnosis. It is quite clear that such explanation concedes the whole position. As a matter of fact, however, in the author's personal series of cases, the diagnosis of "benign giant-cell sarcoma" was made not only by competent pathologists, but in many cases by the very pathologists who had made a most careful study of bone tumors, so that if men of such wide experience are unable to differentiate the benign from the malignant type until death from metastases occurs, how much less likely is it that pathologists of ordinary experience will be able to make such differentiation?

We must admit that the treatment of giant-cell sarcoma of the long bones, by radium or X-ray, is at present in an experimental stage, and the results thus far obtained do not warrant us in giving up the standard method of surgical treatment (curettage) with or without the subsequent use of radium or toxins.

The end-results following the different methods of treatment would seem to justify us in regarding the best method of treatment of these giant-cell tumors as follows:

- a Exploratory operation with curettage of all the tumor that it is possible to remove,
- b Swabbing out the cavity with pure carbolic acid and alcohol or zinc chloride,
- c Packing the cavity firmly with gauze to control hemorrhage,
- d Putting up the limb in a circular plaster-of-Paris cast if there is any danger of pathologic fracture,
- e Keeping the cavity clean with Dakin's solution,
- f Systemic treatment with the mixed toxins of erysipelas and bacillus prodigiosus for a period of three or four months supplemented with at least one massive dose of radium in the form of a pack, *e g*, 12,000 mc hours at 10 cm distance over three areas, if available, if not, X-ray may be used,
- g If the disease recurs in spite of curettage and prophylactic treatment, a second, or even a third curettage may be employed, combined with further

TABLE I
SYNOPTICAL TABLE OF CASES OF GIANT CELL SARCOMA
Radium Cases

Name	Date	Age	Sex	Locality	Duration	Trauma	Clinical diagnosis	Microscopic diagnosis	Treatment	Immediate result	End result
1 L D'G. R & C Hosp	1918	29	M	Lower end	5 mos	No	Sarcoma broken through bony shell, pathologic fracture	No exploration, no mic X-ray & clinical diagnosis positive	Toxins alone systemic injections	Immediate and rapid improvement complete disappearance, replacement with new bone	Perfect function, well January, 1924, 5 1/4 years
2 G Memorial Hosp	1922	33	M	Lower		Fall	X-ray diagnosis Giant-cell sarcoma		X-ray (Dr Herendcen)	First, slight increase in size, later decrease	Much improved able to work January, 1924
3 M I (Case No. 12 in text) R & C & Memorial Hosp	1910	40	I	Lower end	5 mos	No	Central sarcoma giant-cell X-ray diagnosis	Giant-cell benign (Ewing)	Curettage and carbolic recurred, toxins 2 mos tumor disappeared, recurred, radium 4 mos	Steady increase in size, toxins again 3 mos, tumor entirely disappeared, new bone replaced destroyed portion	Well at present, 4 years later, complete restoration of function
4 C H Seen in consultation	1902	29	F	Lower end	5 mos	Yes severe bruise	Sarcoma	Giant cell sarcoma	1st curettage, Sept 1900 and curettage Oct 1900 Dr Hibbs	Remained well after 2nd curettage	Examined by Dr Coley on Nov 19, 1907, patient well 7 years
5 M F Memorial Hosp	1908	26	I	Lower end	Few weeks	Injury several years	Sarcoma pathologic fracture	Giant cell sarcoma (N Y Hosp Lab)	Curettage by Dr Frank Hartley, who advised amputation, this refused, toxins by Dr Coley	Recovery, fracture reunited, new bone formed	Patient well at present 15 years later
6 M M Seen by Dr Coley in consultation treated by Dr Bancroft	1920	30	F	Lower end	3 yrs	Yes fall	Sarcoma, central	Giant-cell sarcoma (N Y Hosp Lab)	Curettage filling with bone wax 1917, recurrence 1 yr, 2nd curettage, radium, X-ray (5 treatments) (Dr Bancroft)	Severe burn from X-ray Dec 1919, resection of radium and ulna for osteomyelitis, 4th operation, May 2 1921	Nov 1920 3 1/2 years after 1st op, wrist-joint ankylosed, marked limitation of motion, metacarpal phalangeal articulations Nov 1923 partial restoration of function Able to work Well 10 years later
7 L W I Seen in consultation	1912	48	M	Lower end ulna	1 mos	Yes strain	Sarcoma central	Giant-cell sarcoma (Bloodgood)	Later operated on by, Dr Bloodgood resection 2 in of ulna	Recovery	
8 I S Memorial Hosp	1911	25	I	Lower end radius	6 mos	No	Central sarcoma	Spindle-cell (mic ex) Giant-cell (X-ray diag)	Exploratory op by Dr Haines, tumor not curetted, Toxins alone for 6 wks (Dr Coley)	Tumor entirely disappeared, complete restoration of function, new bone	Well 3 yrs later when last traced
9 R R Memorial Hosp	1918	30	M	Upper end of fibula	2 yrs		Clinical and X-ray diagnosis sarcoma	Giant- and spindle cell	Operation (Drs Coley and Hogue), profuse hemorrhage, wound fulgurated with Keating-Hart apparatus	3 days later developed gas bacillus gangrene, immediate amputation Recovery	Later history not traced

* This case was treated at other hospitals, seen later by Dr Coley in consultation It has been reported by Dr Bancroft in Clinics of North America, page 1747, Dec 1921

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TABLE II
SYNOPTICAL TABLE OF CASES OF GIANT-CELL SARCOMA
Humerus Cases

Name	Date	Age	Sex	Local-ity	Duration	Trauma	Clinical diagnosis	Microscopic diagnosis	Treatment	Immediate result	End result
1 S T C (Case No 4 in text) R & C & Memorial Hosp	1923	40	F	Upper end	2 mos	Yes recent fracture	Central sarcoma	Benign giant-cell sarcoma (Ewing) (Bloodgood)	Exploratory op May, 1923, toxin treatment 6 wks, radium pick 3 areas, 36 000 mc h	Improved markedly under toxins alone and later, under radium	2 mos, later tumor slowly began to increase in size Nov 7, 1923, has developed metastases in radius Getting worse Feb 1, 1924
2 B P Memorial Hosp	1919	7	F	Upper end	Few months	Yes, recent fracture	Cyst	Giant-cell sarcoma (Ewing)	Curettage, finding clear fluid, scarcely any tumor tissue	Recurred in 2 mos, toxins and radium, recovery	Well 4 years, perfect function
3 H L B (Case No 1 in text) Memorial Hosp	1910	10	M	Upper end	5 wks	Yes, fall, fracture	Central sarcoma malignant	Giant-cell sarcoma epulis type benign (Ewing)	Immediate amputation at shoulder without exploratory operation (Coley)	Recovery, toxins given few weeks after amputation	Developed signs of extensive metastases in lungs 14 mos later Died in Aug, 1911, 18 months after
4 R F (Case No 7 in text) Memorial Hosp	1911	14	F	Upper end	Few weeks	No	Periosteal sarcoma	Tumor of mixed type giant and spindle cells of epulis type (Ewing)	Immediate amputation without exploratory operation (Coley)	Recovery, recurrence in 1 mo	Local recurrence Died 3 months after, from probable metastases of lung
5 C H (Case No 8 in text)	1913	14	M	Shaft	Few weeks	Yes recent fracture	Sarcoma suspected	Giant-cell mixed type (Vanderbilt Univ Laboratory)	Patient referred by Dr H H Trout of Roanoke Va Fracture repaired by Lane plate Plate removed in 6 wks due to infection, exploratory operation, amputation at shoulder	Recovery 1 year later developed metastatic tumor in femur and ilium	General condition grew worse, died of multiple metastases
6 P E Memorial Hosp	1920	6	F	Upper third	Few weeks	Yes, fall	Giant-cell sarcoma X-ray diag or cyst	No microscopic examination	X-ray treatment 6 mos, by Dr Herendeen	Pathologic fracture developed later, re-united	Doing well when last traced 1 year later

TABLE III
SYNOPTICAL TABLE OF CASES OF GIANT-CELL SARCOMA
Fibrosarcoma

Name	Date	Age	Sex	Location	Duration	Trauma	Clinical diagnosis	Microscopic diagnosis	Treatment	Immediate result	End result
1. K. V. R. A. C. & Memorial Hosp	1901	17	F	Lower third	11 mos	No	Sarcoma	Giant cell sarcoma	Curettage Oct 1901, and curettage Jan 1905—8 oz. of reddish brown tumor Op., prolonged toxin treatment X-rays	New bone formed with complete restoration of function	Patient in good health at present 19 yrs later
2. C. J. C. R. A. C. Hosp (See ANNALS OF SURGERY, Dec 1919) (Case No 15 in text)	1915	17	F	Upper end	6 mos	No	Sarcoma central	Giant cell (Lewing) Fibro sarcoma (Barrie)	Curettage and toxins	Recurred in 1 mos., and curettage recurrence, toxins and radium	Recovery, well at present, 8 years later
3. J. N. (Case No 2 in text) Memorial Hosp	1919	21	M	Upper end			Central sarcoma	Giant cell sarcoma type benign (Lewing) Bloodgood Mallory, Wolbach), Osteo sarcoma with giant cells (Knox Wood)	Curettage, radium (bare tubes placed in cavity 2 wks later)	Did well for 7 mos., recurrence, and curettage, infection, amputation	Extensive metastases in both lungs 4 mos later Died
4. J. K. Memorial Hosp	1911	30	F	Upper end	11 mos	No	Central sarcoma	Giant-cell (Lewing)	Curettage	Not traced beyond 1 months	Not traced
5. M. G. Memorial Hosp	1922	35	F	Upper end	10 mos	Yes fall	Central sarcoma X-ray giant cell	No microscopic ex	X-ray treatment at Memorial Hosp from June 1922 to Oct 1923 by Dr Herenden	Tumor increased slowly in size but X-ray showed increased density due to deposit of calcium salts	Under treatment Oct 1923
6. D. S. (Case No 6 in text)	1911	11	M	Upper end	2 mos	Yes fall	Sarcoma	Giant cell sarcoma	Amputation by Dr Lucid of Syracuse N. Y. Aug 1913 2 mos after first noticed	Recovery remained well until Oct 1911 then developed typical central sarcoma of radius	Dec 1911 tumor involved lower 3 inches radius, bony shell broken through involved ulna involved triceps used temporary improv Death July 1915 metastases in pleura

PROGNOSIS IN GIANT-CELL SARCOMA

7 J S (Case No 3 in text) Memorial Hosp	1921 44	F	Upper end	5 mos	No	Central sarcoma	Giant-cell of epulis type (N Y Hosp and Presby Hosp Lab and Dr Lwing)	Curettage and radium (bare tubes, silver tubes, pack) for 10 mos	Disease held in check but not controlled Amputation Oct 26 1921 at Presbyterian Hospital	Local recurrence, metas- tases, death a few months later
8 M C (Case No 16 in text) R & C Hosp	1920 20	F	Upper end	4 mos	Yes fall	Central sarcoma malignant, in- volving knee- joint	Giant-cell sarcoma (Lwing)	Curettage, toxins (Dr Coley)	Recovery, well 6 mos, recurred rapid growth, 2nd curettage, infec- tion, amputation	Well at present, nearly 3 years
9 C Rogers	1910 16	F	Upper end	Pain 7 mos	No		Round- and giant-cell sarcoma	Curettage by, Dr Stein- hardt, toxins after operation (Dr Coley)	Recovery	Well 12 years
10 P H Memorial Hosp	1918 62	M	Upper end	4 mos	No	Sarcoma	Giant-cell epulis type (Lwing)	Curettage (small endo- steal tumor)	1 radium-pack treat- ment (12,200 mc hrs) by, Dr Stone	Patient well 5 years later
11 S B Memorial Hosp	1918 23	M	Upper end	Few months	?	Sarcoma	Giant- and spindle cell sarcoma giant cells epulis type	Curettage N H Hosp, Apl, 1918, bone wax in cavity Radium treatment at Memorial Hospital	Unable to trace case since discharged from hospital	Not traced
12 T McG R & C Hosp	1895 13	M	Upper end	2 wks	Fall 2 mos before	Tumor of tibia	Giant-cell sarcoma	Curettage Dec 1895, 2 mos later rapidly- growing recurrence, amputation Apl 1896 (Dr Coley)	Recovery	Not traced
13 B P Memorial Hosp	1909 9	F	Upper end	1½ yrs	?	Central sarcoma	Giant-cell sarcoma (LeConte Chicago)	Primary amputation by Dr Charles A Parker Chicago	Recovery Prophylac- tic toxin-treatment ad- vised by Dr Coley, but not given	Patient well several years later

TABLE IV
SYNOPTICAL LABEL OF CASES OF GIANT-CELL SARCOMA
Femur Cases No 1

Name	Date	Age	Sex	Locality	Duration	Trauma	Clinical diagnosis	Microscopical diagnosis	Treatment	Immediate result	End result
1 R L Montefiore Hosp for Incurables	1898	19	I	Upper third	Few months	Recent fracture	Central sarcoma inoperable pathologic frac	Giant-cell sarcoma Prof F M Prudden	1 Mixed toxins of erysipelas and bacillus prodigiosus 2 Injections sodium arsenate 3 Curettage (Dr John Rogers)	Slow recovery re union of pathologic fracture	Well 8 years later with useful limb
2 Case of Dr Winter (Case No 9 in text)	1908	14	M	Lower end	5 mos	Shortly before	Inoperable when first seen, 5 mos from beginning	Giant-cell sarcoma	Toxins 21 doses	Decrease in size in 1 mo, later tumor increased in size	Died 2 mos later, tumor very large, probable metastases in iliac p/ands
3 C C S Seen in consultation with Dr Lewis S Pilcher	1905	12	M	Lower end	18 mos	Sprain	Sarcoma, probably malignant	Typical giant cell with very little stroma N Y Hosp Lab	Amputation advised but refused, curettage	Slow recovery	Patient well 2 years later when last traced
4 L R (Case No 5 in text)	1906	16	F	Lower third	3 mos	No	Central sarcoma malignant	Giant cell sarcoma	Toxins 1 mo, slight improvement at first, amputation followed by 32 doses of toxins	Good recovery	Remained well for nearly 3 yrs, then died of metastases in pelvic bones and probably in lungs
5 C R & C & Memorial Hosp	1908	55	F	Upper third	Fractured hip 5 yrs before, and in 3 yrs ago	Fall 5 yr Fall, 3 yr	Sarcoma	Giant- and spindle cell sarcoma	Toxins few doses, no effect	Tumor increasing in size	Not traced
6 M O Seen in consultation by Dr Coley Case of Dr Lyle Case No 18 in text	1921	34	M	Lower end	7 mos	Struck by heavy weight	Bone cyst or giant cell sarcoma	Myeloid sarcoma giant cell	1 Curettage carbolic acid 2 Curettage muscle implant	Good recovery	Well 2 1/2 years later
7 L G (Case No 13 in text) R & C & Memorial Ho p	1914	21	F	Lower third	8 mos	No	Central sarcoma malignant	Giant- and spindle cell sarcoma (Dwight)	Exploratory op for diagnosis, no curetting, knee-joint involved Toxins for nearly 1 year	Immediate and continual improvement, complete recovery, 2 1/2 inches shortening	Well 9 years later

PROGNOSIS IN GIANT-CELL SARCOMA

8 C S (Case No 14 in text) Memorial Hosp	1916/29	F	Lower third invol- ving knee- joint and tibia	7 mos	No	Central sarcoma malignant	Giant- and spindle-cell sarcoma (Lwing)	Amputation advised but refused, curetting fol- lowed by toxin for 2 mos, 1 steel needle and radium pick	Complete recovery with full restoration of func- tion	Well 7 years later	
9 A J McC Memorial Hosp	1911	41	M	Lower third	4 mos	Fall	Central sarcoma	Giant-cell sarcoma (Mass Gen Hosp Lab)	Curettage with bismuth paste, April 1910 (Dr Seudder) Toxins few doses after op, Jan, 1911 toxins given 6 mos (Dr Coley)	Growth checked, old si- nus never healed Jan, 1912, severe infection made amputation nec- essary Recovery	Died 1 1/4 years later of nephritis
10 C H S Dr Bull's Pri- vate Hosp	1911	47	M	Lower third	1 yr	Repeated injuries	Central sarcoma	Giant- and spindle-cell sarcoma (Lwing)	Mixed toxins for 1 yr Disease controlled	1 yr later, injury, popo- liteal artery, amputa- tion	Well 10 years
11 R S R & C Hosp	1918	17	F	Lower end	6 wks	Fall, 4 wks before	Central sarcoma	Giant-cell sarcoma (Lwing)	Curettage, toxins	Became infected 1 mo later amputation	Well 5 1/2 years later
12 L R Memorial Hosp	1920	40	M	Lower end		Yes severe blow	Central sarcoma	Giant-cell sarcoma epulis type (Lwing)	Curettage followed by radium treatment 1 1/4 years	Recovery	Well 3 years later, Dec, 1923, fracture of femur just above old tumor, following fall
13 R S Memorial Hosp	1922	22	F	Lower third	10 mos	Yes	Central sarcoma giant-cell (X-ray diag)	No mic ex	X-ray treatment	Disease nearly station- ary	1 year later, little change
14 L B Memorial Hosp	1921	50	M	Lower end	3 mos	Yes blow	Central sarcoma	Giant-cell epulis type (Lwing)	Curettage, X-ray rad- ium (7000 mc hr over period of 1 yr)	Recovery, 1 yr ago de- veloped ulceration from radium burn, atrophy and fibrosis of soft parts of lower shaft, very severe pain, Am- putation Oct 1923	Disappearance of pain Died Feb 10, 1924

SYNOPTICAL TABLE OF CASES OF GIANT CELL SARCOMA
Giant cell Femur Cases No 2

Name	Date	Age	Sex	Locality	Duration	Trauma	Clinical diagnosis	Microscopic diagnosis	Treatment	Immediate result	End result
15 G M Memorial Hosp	1922	26	M	Lower end	1 yr	Yes recent fracture	Central sarcoma (X ray and clinical diag)	No mic ex	Radium March 1922 at Memorial Hosp	Improvement at first, later increase in size 7 16 23 mm evidence of extension of process	Under treatment
16 L D Memorial Hosp	1921	26	M	Lower end	?	?	Central sarcoma	Giant cell tumor not malignant (Ewing)	Radium	Improvement	Not traced
17 S S (Case No 10 in text)	1916	19	M	Lower third	1 yr	Yes kick	Central sarcoma	Giant-cell sarcoma (Summers)	Local operation, then amputation (Hartwell) Oct 1915	Did well for 11 mos then developed metastases in iliac glands and lung	Died Nov. For full report see text
18 I F Memorial Hosp	May 1923	57	F	Upper third	8 mos	No	Central sarcoma	Giant-cell sarcoma (X ray diagnosis)	X-ray treatment by Dr Herendeen	Improvement	Under treatment
19 R Memorial Hosp	May 1923	25	M	Lower third	Few months	Yes	Central sarcoma one condyle	Benign giant cell sarcoma (Ewing)	X-ray treatment by Dr Herendeen	Improving	Under treatment, Jan 1924
20 T R Memorial Hosp	1900	28	F	Lower third	Few months	?	Central sarcoma	Giant-cell sarcoma (Bender Laboratory Albany)	Amputation (Dr A Vander Veer)	Recovery	Examined by Dr Coley 20 yrs after op, in good health. Slide of tumor also examined
21 T Memorial Hosp	1914	50	M	Lower third	Yes	Central sarcoma	Central sarcoma	Giant-cell sarcoma	Amputation (Chatham Hosp Ontario Canada) toivins after amp	Recovery	In good health 6 years later
22 S (Case No 11 in text) Memorial Hosp	1923	Ad F	F	Lower third	Pain few months	Giant-cell sarcoma X-ray cell sar exam after exploratory operation	After amputation Highly malignant spindle cell sarcoma	Ex op at Flower Hosp Radium and X ray 2 casts applied at another hosp and Crippled Hosp Amputation at Memorial Hospital	Recovery	Well 7 months later	

PROGNOSIS IN GIANT-CELL SARCOMA

use of either toxins or radium. If at the end of six months the disease is still progressing, resection or amputation may be indicated,

h Primary amputation should very rarely be performed in any type of central giant-cell sarcoma without a prolonged preliminary trial of conservative treatment

i Clinical evidence of malignancy; rapid growth, breaking through the bony shell should outweigh the histological evidence of a benign giant-cell tumor, and in cases of this type, amputation should be performed after a brief trial of conservative treatment, if the disease is not controlled

BIBLIOGRAPHY

- Paget Lecture on Surgical Pathology, No 28, part 1, p 446
 Lebert Physiologic patholog, D Balliere, 1845, vol 11, p 120
 Nelaton Tumeurs benignes des os ou tumeurs a myeloplaxes, Paris 1860
 Bloodgood ANNALS OF SURGERY, 1910
 Bloodgood ANNALS OF SURGERY, April, 1919
 Bloodgood American Journal of Surgery, May, 1923
 Martland Proceedings of the New York Pathological Society, 1921, vol XXI, Nos 1-5
 p 102
 Haussling and Martland ANNALS OF SURGERY, April, 1916, p 455
 Barrie ANNALS OF SURGERY vol 111, Surg, Gynec and Obst, 1914, vol 111
 Adams The Principles of Pathology, 1910, vol 1
 Ewing Archives of Surgery, 1922, vol 14, p 496
 Mallory The Principle of Pathologic Histology, Philadelphia, 1914, W B Saunders
 and Co
 Kocher Beit z klin Chir, 1906 Bd 50, Hft 1, p 118
 Coley Journal A M A vol 14, p 333
 Coley Transactions of Third International Conference of Cancer Research, Brussels,
 August, 1913
 Coley ANNALS OF SURGERY, December, 1919, vol 111, No 6
 Coley ANNALS OF SURGERY, March, 1913
 Coley ANNALS OF SURGERY, March, 1907
 Stewart Lancet, November 28, 1914
 Stewart Lancet, November 25, 1922
 Gross American Journal of the Medical Sciences, 1879
 Shattock British Journal of Surgery, 1923, vol 11, p 127
 Waugh and Turner ANNALS OF SURGERY, December, 1923
 Morton Generalized Types of Osteitis Fibrosa Cystica, Archives of Surgery, May, 1922
 Morton and Duffy Archives of Surgery, November, 1923
 Gibbon Jour of Bone and Joint Surgery, July, 1922, p 512
 Auge and Roux Bull de l'assoc franc pour l'etude du cancer 1922, vol 11 p 616
 Bovai Journal of Bone and Joint Surgery, vol 14, No 4, p 652
 Greenough Simmons and Harmer Jour of Orthopaedic Surgery, November, 1921, vol
 11, No 11, pp 602-637
 Bancroft Clinics of North America, December, 1921, p 1747
 Osgood and Collaborators Archives of Surgery, May, 1923, vol 16, pp 858-908
 Ewing and Stone Archives of Surgery, September, 1923

TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting Held December 3, 1923

The President, DR JOHN H JOPSON in the Chair

CONDYLAR FRACTURE OF THE HUMERUS

DR E G ALEXANDER presented a boy, four years of age, who was admitted to St Christopher's Hospital, September 17, 1923, with an injury of the lower end of the left humerus sustained as the result of a

fall downstairs

Examination showed a supracondylar fracture with forward and inward displacement of the upper fragment (see Fig 1)

Three attempts at bloodless reduction under ether having failed to improve the position, on September 26th, the fracture area was opened by a three-inch long incision on the inferior anterior surface of the arm over the lower end of the upper fragment and open reduction



FIG 1 —Supracondylar fracture of the humerus before reduction
Case I

attempted, a great deal of difficulty was encountered on account of the cartilaginous nature of the lower fragment. No internal fixation apparatus or suture was used. The upper fragment was freed of the soft tissue and pushed backward and inward in apposition to the lower fragment. The wound was then closed and the forearm placed in acute flexion. The X-ray (Fig 2) showed almost perfect reduction. At the end of three weeks the patient was discharged and referred to the dispensary for further treatment. Wound completely healed.

The reporter thought this fracture to be of interest on account of the unusual deformity and the great difficulty of reduction. The patient would probably have gotten a fair functional result if the fracture had been left alone. It is hard, at this age, if the fracture had not been

CONDYLAR FRACTURE OF THE HUMERUS

reduced, to really say how much deformity would have resulted. The "gun-stock" deformity and the loss of the carrying angle are the two possibilities. He was surprised at operation to find no callus, although the fracture was twelve days old.

The case is not a supracondylar fracture. It could be classed as a condylar fracture or as an epiphyseal separation. The



FIG 2 —Case I after reduction



FIG 3 —Supracondylar fracture of the humerus before reduction
Case II

condyles were fractured, but the portion between the condyles was smooth, as if it was an epiphyseal separation. It is too soon to record the end result.

DOCTOR ALEXANDER presented a second case of fracture at the lower end of the humerus, in the person of a boy, age eight years, who was admitted to the Episcopal Hospital, October 13, 1923, with the diagnosis

of supracondylar fracture of the right humerus. On the day before admission he fell off a fence. He thinks he fell directly on the right arm, with the arm in the outstretched position. There was present about the

elbow a large amount of swelling with discoloration of the soft parts, there is an abrasion of the skin immediately above the internal condyle of the humerus, localized pain, mobility, ecchymosis, swelling, deformity, loss of function and crepitus over the supracondylar region of the right humerus X-ray (Fig 3) showed a fracture through the condyles of

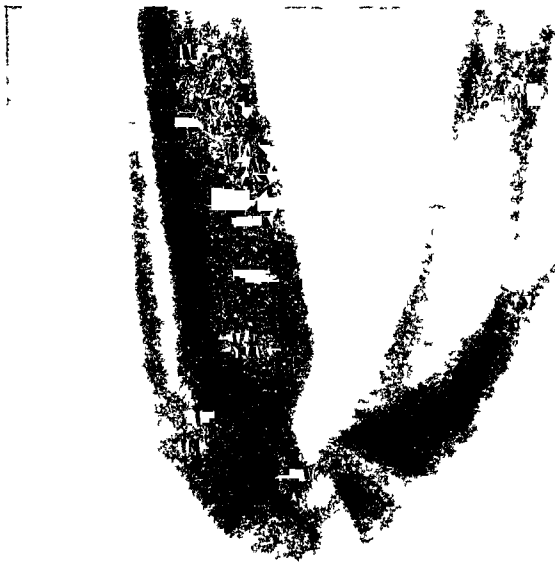


FIG 4—Case II after reduction

the right humerus with displacement backward for the entire diameter of the shaft of the lower fragment It is also displaced outward for one-third of the diameter of the shaft in the antero-posterior view Attempts at reduction without anaesthesia were unsuccessful

October 20th, under ether anaesthesia, reduction was accomplished by forcible hyperextension of the forearm and then bringing the arm

up in acute flexion "X-ray (Fig 4) shows fracture almost completely reduced" Patient discharged from the hospital and referred to the surgical dispensary for further treatment

This case was shown along with the preceding case to emphasize the fact that in eight days after a fracture of the lower end of the humerus in a child, sufficient callus was not present to interfere with reduction

PARTIAL RUPTURE OF THE INTESTINE

DOCTOR ALEXANDER presented a boy, aged eleven years, who was admitted to the Episcopal Hospital, October 6, 1923, with the history that about three hours before admission he was roller skating on the street and fell, striking his abdomen on the pavement He has since vomited seven or eight times, but has not vomited blood He has pain in the lower left quadrant of the abdomen, is unable to void urine, complains of thirst and is very restless The child was a rather pale, thin young male of about eleven years of age, complaining of pain in the lower part of the abdomen but apparently not of a serious nature No symptoms externally The abdomen was slightly scaphoid in type, no abrasions or ecchymosis no masses palpable no dullness in the flanks On palpation over the lower left quadrant of the abdomen there is superficial tenderness and rigidity present There was no peristalsis in this area

THROMBO-ANGEITIS OBLITERANS

Under ether anaesthesia the abdomen was opened through a left rectus incision. On opening the peritoneum a milky fluid was encountered, this was cultured. The intestines were then examined, and in the lower ileum a partial rupture of the wall of the gut was found, which extended through the peritoneal and muscular coats down to the mucous membrane. The rent in the intestinal coats was closed, a rubber tube was placed in the pelvis and the wound closed. The rubber tube was removed the day following operation as the culture showed no growth. The patient made an uneventful recovery and was discharged from the hospital on October 23, 1923.

This case emphasizes the fact that serious intra-abdominal injury may take place without any visible external signs, as abrasions, ecchymosis, etc. It also emphasizes the fact that in all abdominal injuries localized pain and rigidity and the absence of peristalsis warrants one in opening the abdomen.

GUNSHOT WOUND OF THE ABDOMEN

DOCTOR ALEXANDER presented a lad aged sixteen years, who was admitted October 5, 1923, with the history that shortly before, while he was unloading a 25-calibre automatic pistol, it was accidentally discharged, the bullet entering his anterior abdominal wall and coming out of his back. When admitted he was markedly shocked. Temperature 98. Pulse 114. Respirations 30. Pulse volume low. Immediately below and slightly to the right of the umbilicus in the abdominal wall was a small puncture wound, black in color, with inverted edges, from which a small amount of blood was oozing. In the back, on the left side, slightly below the level of the umbilicus, was the wound of exit of the bullet, a considerable ooze also coming from this wound. The abdominal muscles were rigid, there was dullness in each flank and no peristalsis to be heard. Without delay the abdomen was opened by a right rectus incision. On opening the peritoneum a large amount of fluid blood gushed forth. The intestines were carefully examined for perforations and none found. Clots were found in the omentum and a large hæmatoma could be seen behind the posterior peritoneum in the pancreatic region. The bullet hole could easily be seen in the anterior parietal peritoneum, but no opening could be found in the posterior peritoneum. The abdominal cavity was sponged free of blood, possibly a litre of salt solution poured in, and the wound then closed without drainage. The patient was immediately transfused by the citrate method and anti-tetanic serum given. Recovery was uneventful and the patient was discharged from the hospital on November 24, 1923, in good condition.

THROMBO-ANGEITIS OBLITERANS

DOCTOR ALEXANDER presented a man, aged fifty-three years, who was admitted to the Episcopal Hospital, April 2, 1923, on account of gangrene of toes due to thrombo-angitis obliterans. Seven years ago gangrene developed in the left foot and his left leg was amputated at the Samaritan Hospital. His present illness began as a soreness in the toes twenty-one weeks before admission to the hospital. Had been at home in bed for nineteen weeks under the care of his family physician. Has

a feeling of numbness in the toes and suffers a great deal of pain, especially if the foot is exposed to heat

When admitted he appeared a fairly well developed adult white male, whose left leg had been amputated about four inches below the knee. The great toe, index and middle toes of the right foot are now blue in color and cold, an ulcer is present on the under inner aspect of the great toe, the other toes are slightly discolored. Pulsation in the posterior tibial and dorsalis pedis faintly felt. Blood sugar and urea normal. Urine negative.

The patient was kept in bed with the foot elevated, heat was applied and he was given potassium iodide internally. He suffered a great deal of pain and for this intravenous injections of sodium citrate were given without any beneficial result. Morphine was frequently given to relieve the pain.

April 19, 1923, peri-arterial sympathectomy was performed. Following the operation the pain was greatly relieved for a few days. However, the gangrene in the toes became steadily worse and on May 10, 1923, the first and second toes were amputated. Following the operation the patient continued to have pain in the toes and foot, and occasionally complained of pain in the sympathectomy wound. The gangrene continued to progress until on June 11, 1923, a Chopart's amputation was performed. On account of the devitalized and infected nature of the foot, the wound was left open. Following the operation the remaining part of the foot and lower third of the leg became very much swollen, red and tender. This area was opened and drained of the pus which was found above the ankle. The patient rapidly began to improve, all his pain entirely disappeared, and the wounds began to clear up. The wounds finally entirely healed and the patient was discharged from the hospital in good condition.

The arterial sympathectomy had had no effect on the gangrene of the toes which, when the operation was performed, was becoming steadily worse. The pain was greatly relieved immediately following the operation, it recurred however, in a few days, but never to be quite as severe as it was previous to the sympathectomy. The pain following the operation seemed to be more intermittent in character, the patient often going several days without complaining sufficiently to require a narcotic. Sodium citrate intravenously for the relief of pain in arterial disease seems in his experience, to be a most unreliable and overrated measure.

DR ASTLEY P. C. ASHHURST, who had seen the first case with Doctor Alexander, said that when he found it had been nine days since the child was hurt he was dubious as to whether or not he could reduce the fracture after so long an interval. Although he pulled as hard as he could, did not secure reduction. However, he thought that if the elbow was left alone, the child probably would get as good a result as if an open reduction were done, and for the following reasons. First the child already had complete flexion of the elbow, second, the lower fragment, though posterior, was more

external than internal, so that the development of cubitus varus was not to be feared, third, the fact of the child's extreme youth was in favor of the spontaneous architectual rearrangement of the bone fragments, so that ultimately a reasonably good result would be assured. On the other hand, open reduction at a stage after the injury when so much new subperiosteal bone has already formed, has usually resulted in a stiff elbow in the cases he had seen treated by other surgeons by operation. He had never himself had occasion to operate on so young a child. He thought that Doctor Alexander's second patient showed how useless it is to put the elbow into hyperflexion until reduction is secured. To secure reduction one has only to reverse the process by which the fracture occurred, namely, hyperextension, longitudinal traction, and eventual complete flexion, which he called hyperflexion. When the elbow is flexed it is very important not to flex it in any other than the sagittal plane. If it is flexed up and toward the chest a cubitus valgus will be present when the patient gets well. If it is flexed too much away from the chest, one will get cubitus varus. When flexed one can do what one will with the forearm because the lower fragment is locked on the shaft of the humerus, and the whole extremity—the forearm, elbow, and upper arm—move as one piece. One need not fear rotating the fully flexed elbow in toward the chest, because if the elbow is kept in hyperflexion it is immaterial what is done to the shoulder joint, where alone rotation will occur.

To maintain the elbow in hyperflexion, no dressing is so simple as a roller bandage. First powder the crease of the flexed elbow, and place a small sweat pad in it. Begin with a number of turns of the roller bandage around the wrist, and include the hand in the bandage. Then return to the wrist and again take a number of turns of the roller around the wrist, before carrying the bandage across to the arm below the axilla. Neglect of the precaution to put enough turns around the wrist to make a firm pad of bandage here, may cause the bandage to produce a slough over the subcutaneous border of the ulna, when the roller is drawn taut from this point across to the arm just below the axilla. Then carry the roller back and forth from arm to forearm, bandaging in the elbow much as one would an amputation stump. Finally, carry the same continuous bandage around the child's neck, suspending the wrist from the neck. In all cases the hand, at least its thumb, should lie on the same side of the neck as the injured elbow. If the hand lies on the other side of the neck, the elbow has not been flexed acutely enough to prevent displacement of the lower fragment.

DR JOHN H. JOPSON spoke of the possibility of Volkmann's contracture following treatment of fracture of the elbow by acute flexion. In the early stages, he would hesitate to use forced flexion to the degree recommended by Doctor Ashhurst. He was satisfied to adopt a position of moderate flexion, after reduction under anæsthesia, and later raise the hand to the higher level. He had been well satisfied with the results thus obtained.

PHILADELPHIA ACADEMY OF SURGERY

DR HENRY P BROWN said that he expected to show at the next meeting a Russian Jew, thirty-six years of age, who showed evidence of endarteritis obliterans in both feet Doctor LeConte performed a sympathectomy on the right side with immediate relief of the pain He did so well, Doctor LeConte wanted him to have the operation done on the left side, but he would not submit Seven or eight months later the left side became so much worse that he was very anxious to have the operation done At the time of operation on the left side the contraction of the femoral artery which always follows this operation was just sufficient to shut off the blood supply to the foot and the man had subsequent gangrene and the foot was removed at the end of two or three weeks Pain was relieved at time of operation The right side did very nicely No pain at all At present he walks around on crutches

DR A E BILLINGS said that at the Jefferson College Hospital they had had a number of cases of sympathectomy All had been relieved from pain with the exception of two, which came to amputation for gangrene One patient with beginning gangrene of the great toe was finally relieved from pain and it is now one and one-half years since the operation He is still entirely comfortable and goes to work Another case operated on one and one-half to two years ago is well Two patients have come to amputation since and the other day he amputated the leg of a patient whom Doctor LeConte had operated on nine months ago with relief only for a short time

DR GEORGE P MULLER had performed sympathectomy eight times for Buerger's Disease, without very satisfactory results from the standpoint of recovery from cyanosis or threatened gangrene The exception was a patient past middle age who had beginning gangrene of the little toe, after sympathectomy he made a wonderful anatomical recovery and has remained well since about two years In three of the cases there was distinct relief from pain and in the other four there was no improvement They went on to amputation Leriche's theory is that it relieves vasomotor constriction and improves the blood supply All of these patients were neurotic, and were mostly Russian Jews The trouble with patients with Buerger's disease is that in addition to the neurosis they also have thrombosis, and the vessels are almost obliterated Therefore you cannot get vasodilatation of the vessel You can relieve the pain by cutting the afterent Buerger says the thrombosis does not extend to the capillaries but involves the larger vessels, and the hope of sympathectomy is that you can improve the capillary circulation Kroh shows that while the capillaries may not have muscle walls, yet they have cells which expand under stimulus The speaker's results had been disappointing in senile and diabetic gangrene

DUPLEX KIDNEY WITH PYONEPHROSIS

DR LION HERMAN presented a post-mortem specimen showing pyonephrosis affecting the lower half of a duplex kidney The individual, a woman of seventy years of age, from whom this kidney was removed,

POST-OPERATIVE PULMONARY COMPLICATIONS

came to the Methodist Hospital in 1921, with symptoms suggestive of acute left-sided pyelitis. The cystoscopic examination revealed duplicity of the left ureter with infection of the lower pelvic segment. The condition seemed to be a chronic one with an acute exacerbation of the infection. A pyelographic and differential functional study showed a relatively normal upper segment with an infected and functionless lower segment. The patient had diabetes, and after due deliberation it was deemed inadvisable to attempt operation, although the findings suggested the possibility of doing a hemi-resection of the kidney. They were able to keep the infection under control by pelvic lavage, but for a long time the patient absented herself from the clinic. Several weeks ago she was admitted to the medical service of Dr. George Norris in the Pennsylvania Hospital with a very severe attack of renal infection, together with other complications which have now proved fatal. Drainage of the pyonephrosis by means of the ureteral catheter and pelvic lavage were of no avail for reasons that became evident at the post-mortem table. The pyonephrotic sac had ruptured, or at least the infection had spread beyond the limits of the sac and there was purulent infiltration of the psoas muscle and a massive left-sided empyema.

There was incomplete duplicity of the right ureter, but neither segment of this kidney had become infected.

TEMPORO-MANDIBULAR ARTHROPLASTY

Dr. GEORGE M. DORRANCE read a paper with the above title, for which see page 485.

POST-OPERATIVE PULMONARY COMPLICATIONS

The annual oration in surgery was delivered by Dr. WALTER ESTELL LEE, with the above title. For this address, see page 506. Doctor Lee also reported the following case:

The patient was a lad, sixteen years of age, who was admitted to the Germantown Hospital, March 12, 1923, with acute appendicitis and operated upon the same day by Doctors Murray and Bloomhart. The swollen, partially necrotic appendix was removed. He left the table in very good condition on the third day, post-operative, having been fairly comfortable, up to that time he began to complain of pain in the right anterior chest.

Examination at this time of the anterior chest showed a peculiar ringing but dull note upon percussion from the level of about the second rib downward, extending to the side to axillary line, but did not seem so much in evidence here. Posteriorly the patient was not examined. By auscultation over the designated area in the anterior chest, the whispered voice was diminished and in the upper part numerous moist, coarse râles could be heard. Tactile fremitus seemed but little diminished. At this time the apex beat of the heart could neither be seen nor felt to the left of the sternum. There was a visible pulsation synchronous with the heart beat, placed about one inch to the right of the right border of the sternum and in the fourth interspace. The heart sounds

were transmitted over the entire right chest, but were heard the strongest over the point where the pulsation was visible. At this time tentative diagnosis was made of pneumothorax with a possibility of a tuberculous origin. Also a condition of dextrocardia was thought probable.

March 16, 1923—The physical signs were very similar to those found at the last examination, except that the ringing quality of the percussion note was less marked and fewer râles seemed to be present. The position of the heart seemed somewhat more to the left so that pulsation could be seen and felt in the fifth interspace to the left of the left border of the sternum but considerably within the normal location of the apex beat. A heavy, muco-purulent sputum is constantly raised.

March 17, 1923—The heart has returned to the left somewhat, taking a position behind the sternum, the sounds are quite as forceful as ever. Friction rub heard distinctly over both sides anteriorly.

Notes by Doctor Geisler. Lungs—Left lung shows a compensatory hyperactivity, right lung diminished expansion in the upper lobe, a few sonorous râles are heard and the respiratory note is exaggerated. Middle or lower lobes show dulness varying in intensity on change of posture but never quite clearing, with distant breathing in some parts and absent breath sounds in others. Vocal resonance well transmitted and occasionally egophonic in small areas. Probably due to a loculated effusion or a thick, fibrinous effusion.

March 18, 1923—General condition not so favorable as has been. The physical signs are about the same. The heart area is well defined about one inch to the right of the sternum, where the pulsation is visible in the fourth interspace. Râles diminishing. Ringing quality of percussion note somewhat diminished anteriorly. Posteriorly a decided ringing quality is heard at the level of the spine of the scapula. Breath sounds here are exaggerated and the spoken voice is so loud at this level that it is almost painful to one's ears. Spoken voice slightly increased at the base, where a suggestion of egophony is present. Râles are heard as well posteriorly.

Drainage is free from the incision. The pus is thin and watery, with a very foul fecal odor. There is a definite suggestion of a mass present in the right pelvic area and hypogastrium. This is moderately tender. Patient has no pain at the site of the incision but complains of epigastric distress.

March 19, 1923—The ringing note has almost disappeared in the anterior chest. Heart maintains the same position, the râles are still present, and the expectoration continues. General condition is somewhat better, drainage profuse.

March 21, 1923—Left chest still hyperresonant everywhere. No cardiac dulness. Apex beat visible in fourth interspace, one and one-half inches right of median line. Heart sounds heard throughout right chest. Hyperresonance in right chest disappearing and the greatest resonance is over the right upper lobe. Lying on the left side heart dulness moves to one inch to left of median line and apex beat felt in fifth interspace at right of sternum. Upper lobe posteriorly the broncho-

GANGRENE OF APPENDIX RESULTING IN COLIC

scopy has disappeared, but the râles are present Middle lobe posteriorly is silent Lower lobe posteriorly is silent Tactile fremitus present posteriorly, most marked over upper and middle lobes

March 23, 1923 Right border of heart one and one-quarter inches right of median line Beat not felt on the right so distinctly as before Friction rub heard throughout entire right chest Posteriorly the middle lobe is silent, hyperresonance is absent now anteriorly

March 25, 1923 Heart has moved over slightly toward the left Sounds not so distinct in the right chest but still heard there Friction sound has entirely disappeared Incision healing, drainage very slight, and the foul odor has disappeared There is a mass present in the right abdomen about the size of the back of a hand

March 27, 1923 Very difficult to feel heart and pulse on the right but probably felt one inch to right of mid-sternum Definitely felt in fifth interspace one and three-quarters inches to left of mid-sternum He has a definite mass in mid-abdomen below the umbilicus to the inner side of the incision, probably a secondary abscess This would account for his febrile condition

March 29, 1923 Abdominal mass is still palpable, not tender, temperature is normal Is probably going to take care of this infection himself The hyperresonance over the left chest is disappearing Heart dulness is at the right border of the sternum and the left border is one-half inch to right of nipple There is a slight cardiac pulsation visible in the third and fourth interspace to the right of the sternum, but is not palpable

April 18, 1923 - Patient's abdominal condition is entirely cured He developed an acute otitis media, left ear April 2, 1923, the right ear April 3, 1923, for which he has been treated by the ear department with incision of both drums and the ears douched His temperature has gradually become normal and has been so for nine days and the ears are no longer draining Patient discharged recovered

Stated Meeting Held January 7, 1924

The President, DR JOHN H JOPSON, in the Chair

HERNIA THROUGH THE FORAMEN OF WINSLOW

DR MAURICE PIGION (by invitation) read a paper with the above title and presented the patient whose history had prompted the study

GANGRENE OF APPENDIX RESULTING IN COLIC AND DUODENAL FISTULÆ

DR JOHN B DEEVER presented a young man who was admitted to the Lankenau Hospital, October 19, 1916, with the history that three days before his admission, he was seized with general abdominal pain which in a few hours localized in the lower right abdomen He neither vomited after the onset of pain nor after the pain localized Twenty-four hours before he came into the hospital he took citrate of magnesia, which was followed by

not only intense pain, which again became general over the abdomen, but also by vomiting. Examination showed a diffused peritonitis of lower abdomen and no localized point of exquisite tenderness, but the presence of peristalsis beyond and around the area of peritoneal involvement, and the absence of peristalsis over the inflamed portion. Leucocyte count 30,000 with 89 polymorphonuclears, moderately high temperature and rapid and irregular pulse. Treatment, anatomic and physiologic rest.

Two days after admission, the diffused peritonitis having subsided to a localized peritonitis and being able to definitely localize a point of exquisite tenderness low down in the lower right abdomen and well out, the abdomen was opened. The appendix was in the false pelvis, gangrenous and ruptured, there was pus in the pelvis. Exploration of outer pericolic groove negative. Condition satisfactory until November 9, ten days after operation when it was evident that a secondary abscess had formed in the pelvis, with incomplete bowel obstruction.

November 10, a second operation was done, evacuating a large amount of pus from the pelvis and relieving obstruction of the sigmoid due to angulation and adhesions of the bases of the limbs forming sides of triangle. Drainage.

November 17, a fecal fistula through the original incision developed with great pain in the upper right abdomen, with slight pain in left upper abdomen.

November 23 the fecal discharge was profuse and the pain in the right upper abdomen was intense.

November 25 a collection of pus beneath liver was drained. A localized necrosis of the duodenum and the hepatic flexure of colon was exposed, the necrotic areas in both duodenum and hepatic flexure of colon were turned in and oversewn. Drainage of abscess bed.

November 28 a duodenal fistula has formed, fluid taken by mouth escaped by way of fistula, still fecal drainage.

December 3, patient very weak, all fluid nourishment given by mouth escaping by way of duodenal fistula. Skin edges of upper wound much irritated. Fecal drainage through lower wound profuse.

December 4 a large opening in the duodenum was exposed, closed, and a posterior no-loop gastro-enterostomy made. At this operation a small pus collection at site of splenic flexure was evacuated and drained. Following the last operation the patient gradually improved and was discharged January 15 1917, with slight drainage from upper wound, which was not entirely healed but granulating and the fecal fistula still present. The drainage from the upper wound ceased in three weeks and the fecal drainage from the lower wound in six weeks after his discharge.

DOCTOR DLAVER added that he had seen a number of duodenal fistulas and had gotten away with most of them by almost immediate operation. Delay is dangerous on account of the loss of nutriment and starvation as a consequence therefore he operates immediately, in some instances being able to close the fistula in others making an amputation of the duodenum below the site of the fistula and removing with the upper duodenum the pylorus, and last a posterior gastro-enterostomy. These are troublesome and anxious cases, but are amenable to treatment.

DR. GEORGE P. MULLER said that in 1909 he operated on a patient with perforated duodenal ulcer and simply sutured the perforation without gastro-enterostomy. Ten days later a duodenal fistula appeared and discharged

LUNG ABSCESS FOLLOWING TONSILLECTOMY

bile and pancreatic juice, greatly excoriating the skin. Accordingly, a posterior gastrojejunostomy was done through a second incision and in a week the fistula had closed.

FRACTURE-DISLOCATION OF UPPER END OF HUMERUS

DR JOHN B DEEVER presented a man, age thirty-seven, who was admitted to the Accident Department of the Lankenau Hospital, August 9, 1923, complaining of pain in the right shoulder and arm. He had fallen ten feet from a scaffold, striking his right hand forcibly against a wall. Immediately after falling he found that he could not move the right arm. X-ray showed an oblique fracture of the anatomical neck of the right humerus, the head lying beneath the coracoid process.

Operation. August 18, Doctor Pfeiffer. Head of the bone reduced and nailed to shaft. Arm dressed in extended position and plaster bandage applied. X-ray taken a few days following showed recurrence of the dislocation.

On the 27th of August, Doctor Pfeiffer and Doctor Deever removed the nail, reduced the head of the bone and brought the shaft in line with the head, arm dressed to side.

DR DAMON B PREIFER said that he found the head of the bone had been driven deeply into the pectoral muscles and the track had contracted to such an extent it was almost impossible to get it back. It consumed time and produced much traumatism in replacing it. The head was connected to the glenoid by only a single strand of capsule. He therefore nailed it to hold it in place and replaced the head in the socket. Unfortunately during the process of putting on the plaster bandage, the dislocation reproduced itself. Had the patient been on a special fracture table, he doubted if this would have occurred, but the movement incident to transferring the patient to another room, where the bandage was applied, permitted the head, which was so loosely held by the capsule, to fall out of place. The problem in these cases is to get abduction after healing has taken place and this is what he had in mind in attempting to put up the arm in an abducted position. Possibly this can best be done by traction and counter-traction with the arm at right angle to the body, but in view of the extensive tearing of the capsule in these cases, all such measures involve considerable risk of redisplacement. The question of failure of the capsule to reattach itself to the normal points must also be considered as habitual dislocation might easily result. Of course, the bone is most easily held in position with the arm at the side and we must wait for further experience and development of means of fixation to say what is the best method of dressing from the standpoint of future function.

LUNG ABSCESS AND PYONEUMOTHORAX FOLLOWING TONSILLECTOMY

DRS E B HODGE and E R MURPHY presented a little girl, aged six years, who was admitted to the Children's Hospital of Philadelphia, September 22, 1923, with the following history:

On August 29, 1923, under ether anæsthesia, tonsillectomy was performed. She remained in hospital 24 hours, was then taken home where she remained.

in bed for the next three days. On the fifth day following the operation, she was allowed to go to school, apparently well.

On September 14, 1923, sixteen days following operation, she returned from school, complaining of pain in the stomach, coughed a great deal, and was short of breath. She was put to bed and on the following morning had a chill, vomited and became blue.

When admitted to the hospital the child looked extremely ill. Temperature 105. Pulse 150. Respirations 70. She was cyanotic, and expectorating large quantities of purulent sputum. A diagnosis of lung abscess and pyopneumothorax was made. Under local anæsthesia the left pleural cavity was drained through an intercostal incision. The general condition improved and the temperature gradually fell to normal.

On November 7, 1923, bottle blowing was begun. This was followed by a sharp rise in temperature and a return of the purulent sputum. The bottle blowing was stopped, the temperature again fell to normal, and the purulent expectoration ceased.

December 1, 1923, all drainage was removed, the wound closed promptly. The temperature remained normal. There has been a rapid gain in weight. The physical examination at the present time shows no pathology in the left chest which is confirmed by the X-ray.

DR. GEORGE FETTEROLF remarked, there are entirely too many of these lung abscesses following tonsil operations. The literature is full of them. The relation of cause and effect is often not recognized, the usual history being that the patient comes in for a "bad cold on the chest" and the fact that he has had a tonsil operation frequently has to be elicited by questioning, it eventually develops that there had been a tonsil operation and a week or so later the patient began to spit up unpleasant material. In the majority of cases the patient regards it entirely as an independent proposition from the tonsillectomy. Then, again, some of these cases may be treated as tuberculosis, not as lung abscesses. As regards etiology, it has been pretty commonly accepted that they are generally of inhalation etiology, but when it is realized that in one series of 202 cases the proportion done under local anæsthesia was approximately 20 per cent, it puts a new angle in the situation, and makes one think a little more of terms of embolic origin of some of these cases. With this idea in mind last winter Doctor Fox and he did some tonsillectomies on dogs, infecting the wounds and introducing infected sutures into the wounds. As a result of these experiments they found in the paratonsillar tissues interstitial hemorrhages, many thrombi, necroses and bacteria. In other words, local conditions were such that emboli readily could loosen and travel down the internal jugular and eventually into the lung. The three factors in producing septic emboli are traumatism, sepsis and muscular action, and it would be pretty hard to find a place where these three would be more ideally combined than around the tonsil fossa, when the tonsil is taken out. a certain amount of traumatism results, the area is exposed to the constant presence of bacteria, and the throat muscles are in more or less constant action. These findings, so far as paratonsillar tissue is concerned, and again, the fact that a great many of these cases follow local anæsthesia, suggest that

LUNG ABSCESS FOLLOWING TONSILLECTOMY

more attention should be directed to the embolic nature of the affection and less to inhalation. Efforts to prevent lung complications so far have been directed towards keeping the trachea free of blood, etc., with no thought of the wound. The practical developments of these experiments would be to seek for lines of procedure which might add to the safety of the operation. In the first place every patient before tonsillectomy should be given sodium bicarbonate in the hope of preventing vomiting and acidosis, as with vomiting there might be some inhalation of the vomitus and infection of the lung. The next point is light anaesthesia to preserve as far as possible and to favor a quick return of the coughing reflex. The third point is the use of a good suction apparatus to keep the throat as free as possible and the fourth as rigid asepsis as can be secured. The fifth point and the point he wished to emphasize most of all is when the surgeon has to pick up and tie off a bleeding point not to introduce the ligature with a needle, but to use a surface tie as would be done anywhere else in the body, for it is not possible to introduce a suture into the tonsil area, without introducing some bacteria and thus greatly increasing the probability of infecting any thrombi there. An interesting point is that lung abscesses began to be reported when the type of tonsil operation changed and this was about 1912. Up to that time they used a tonsillotome or punch and sliced off the readily accessible parts of the tonsil, in each case a certain amount of tonsil being left behind as well as most of the capsule. When the complete tonsil operation was taken up, the capsule, that wall of fibrous tissue between the lymphoid tissue and the muscles, etc., and the throat, was taken away. In view of the possibilities of septic embolism that might thus be encouraged, a further deduction is that perhaps this type of tonsil operation is not based on correct principles. It may be if one could remove the lymphoid tissue and leave the firm fibrous capsule behind they would be protecting the underlying tissue. An ideal procedure would be to take out the lymphoid tissue and leave the capsule. Whether or not this is practicable only time and further study will determine.

DR HERBERT FOX remarked as to the pathological changes that are in the paratonsillar tissues after a tonsillectomy, that if one will visualize the granulation tissue that must occur about an operation area, particularly if it is infected, it will require little imagination to see how thrombi can start about a tonsillectomy wound, perhaps extend out as far as the main branches of the veins that empty directly into the jugular. They had seen thrombi partly attached and partly loosened in venules in the tonsillar beds. One can easily follow the extent of these thrombi in the main venous trunks, all know that thrombi grow with advancing infections of the pharyngeal wall or of the tongue. Next as to genesis of pulmonary abscess, it is only necessary to assume that there are small emboli which produce small areas of congestion and secondary to that thrombosis, local thrombosis. From such a small focus it is perfectly possible for larger patches to develop. If one realizes that it is not necessary for massive infarcts to occur, that small infarcts can produce

pulmonary abscesses, that there are two varieties of pulmonary abscesses, that which is infiltrated, massive possibly secondary to inspiration, that which is disseminated, small and almost certainly due to emboli

DR JOHN B ROBERTS said that the facts mentioned by Doctor Fetterolf had always impressed him when he had seen this operation done. The etherizer is usually giving unnecessarily deep anæsthesia. There is no necessity for a great deal of ether in this tonsil operation unless one has some other reason for wanting to obtain profound anæsthesia. The clearing of the throat is often inefficiently done, even by those who use, if they be laryngologists, suction apparatus to get blood and mucus out of the pharynx while working. The form of apparatus some otolaryngological surgeons use has seemed to him to be very unsuitable for such an easy operation. It reminds one of the crude and clumsy way by which in years past hysterectomy was done by the extraperitoneal method. Surely no crushing, clumsy ecraseur is needed to control the bleeding arising from removing tonsils.

To do the work neatly, quickly and safely, one needs an etherizer, who will not overwhelm the patient with the drug; an etherizing apparatus with a hook-like metal mouthpiece and a rubber hand blower under the control of the etherizer's own fingers. The patient should lie supine with mouth held open by means of an incisor gag, and the tongue drawn out by means of an aseptic silkworm gut thread thrust with a sterile needle through the tongue. This device is harmless and superior to holding the tip of the organ with tongue forceps. A suction tube should be in the hands of an assistant and a suction pump be attached to it to be used occasionally for drawing blood, mucus and saliva out of the child's throat. A good head mirror will give illumination.

The amygdalectomy is readily performed, under this preparatory technic, with a vulsellum to draw the tonsil up from its bed in the surgeon's left hand, and a bistoury or a midpoint scalpel in his right. A small blade-pointed scissors curved on the flat, will often be found a useful additional instrument for dissecting out the entire gland. Should one or two vessels bleed, a hæmostatic forceps is employed to seize the open end of the artery, left in place for a few minutes, and removed after twisting the grasped vessels two or three turns.

It must be very seldom that any serious hemorrhage can occur then unless the operator cuts very much more deeply than required. Even then leaving the hæmostats in place a little longer is probably all that will be necessary. If by any possibility there should be recurrence of bleeding, the hæmostatic forceps may be left in position and the teeth closed on that handle sticking out of the patient's mouth. The nurse may support the chin so as to close the mouth and steady the instrument in place until the surgeon removes it. It will not be safe to bandage the mouth shut until all risk of vomiting is over.

It is well, in order to make the operation easy to have scissors, forceps and hæmostats with long and rather delicate handles. The habit of some

PERIARTERIAL SYMPATHECTOMY FOR TROPHIC ULCER

laryngologists of stopping a bleeding vessel with a suture puckering up the tissues does not seem wise. It makes a sort of pocket at times in which secretions or blood may accumulate and become septic. Instead of torsion with hæmostats, an old-fashioned tenaculum may be hooked into the tissues alongside of the bleeding artery and given a turn, so as to twist the structures and stop the flow of blood. The flat handle of the hook-shape tenaculum protruding from the mouth may be kept from relaxing the twist of the palatal and columnar tissues by keeping the teeth shut upon it.

PERIARTERIAL SYMPATHECTOMY FOR SCLERODERMA

DR GEORGE P. MULLER reported the case of a woman, thirty-seven years of age, who was referred by Doctor Riesman to his service at the University Hospital, October 12, 1923. About five years ago menstruation ceased after a miscarriage and shortly afterwards was first noted swelling of the fingers. Later they became blue on exposure to cold, and soon the definite appearance of sclerodactyly was noted. Recently, some evidence of the disease is noted in the face. At present the hands present the typical picture of scleroderma. She has pyorrhœa. Blood Wassermann test is negative. Basal metabolic rate +1. Blood-pressure is S 90, D 68 in right arm and S 80, D 60 in the left.

On October 18, sympathectomy was done on the right brachial artery. The artery, when exposed, was about one-quarter the normal size and contracted still further on manipulation. The wound healed perfectly and the improvement was sufficiently marked for the patient to insist on having the left side operated on, this was done October 25 and a similarly contracted artery found. On January 7, 1924, the patient was seen and expressed her belief that considerable improvement had occurred, the hands still became quite blue when cold, but she could handle things better.

Scleroderma seems to be a disease of unknown etiology and is rather rare. Lewin and Haller believe it to be an angio-trophoneurosis. Consequently sympathectomy is justifiable in view of the poor prognosis even if amelioration only is obtained. Doctor Muller has only noted one other case (Horn, 1923) in the literature so treated and the result was an improvement as in the case reported.

PERIARTERIAL SYMPATHECTOMY FOR TROPHIC ULCER

DR GEORGE P. MULLER reported the case of a man, thirty years old, referred by Doctor Pierson to his service in the University Hospital, October 24, 1923. Eight years ago he suffered a lacerated wound of the right ankle from a mowing machine. The tendo-Achillis was severed and sutured. Since then has had disability and swelling. Four years later a fissure formed on the plantar surface of the heel which progressively grew worse until a deep ulcer developed, which now measures 3 cm. in diameter. It is undermined and suppurating. The right leg sweats profusely. On October 27, a right femoral periarterial sympathectomy was performed. The vessel contracted during manipulation. The ulcer on the heel was trimmed and treated with glycerine dressings, later with mercurochrome. The ulcer began immediately to fill with granulations and on November 15, a single Reverdin graft completed healing.

On January 7, 1924, the patient reported that the foot was entirely normal and that he was walking without discomfort.

In an experience of over thirty periarterial sympathectomies Doctor

Muller thinks that this was the most satisfactory of the series. The result was so prompt in a condition of long standing as to be surprising. Bruning has pointed out that the appearance of trophic ulcers is delayed until a neuroma has formed or pressure from the cicatrix begins to act. The tonus of the sympathetic is augmented and sympathectomy acts by lowering the tonus proximal to the field of operation. Leriche states that relapse is possible if the cause of the trophic trouble has not been removed, and that the cause is not always removed by the sympathectomy. If relapse occurs in this case Doctor Muller thinks that the posterior tibial nerve must be investigated in the region of the scar for a possible neuroma.

CONGENITAL FISTULÆ AND CYSTS OF THE NECK

DR BENJAMIN LIPSHUTZ read a paper with the above title, for which see page 499.

DR A P C ASHHURST asked whether such a thing as branchial carcinoma exists? It has been taught for many years that such a thing exists. But no less an authority than Bland-Sutton says it is a myth, and that in every case that has been called a branchial carcinoma if autopsy is done there is a primary growth in the oropharynx of which this tumor of the neck is only a metastasis. Having himself recently operated on a patient with which he diagnosed as branchial carcinoma, and having had the good fortune to get an autopsy after the patient's death, he found in the pharynx a carcinoma. He did not see why the carcinoma inside of the pharynx and the carcinoma in the neck could not have developed in different parts of the remains of the same branchial cleft.

DOCTOR LIPSHUTZ replied that it was difficult to answer with definiteness Doctor Ashhurst's question. The origin of the branchial and thyroglossal fistulæ as interpreted in his contribution is a problem of embryonal cell rests, and if one accepts Cohnheim's theory of the genesis of cancer, then these embryonal cell rests offer a tenable explanation for primary carcinoma in the neck. But until more is known about the question of the degeneration of embryonal tissue, the state of knowledge of this problem will remain where it is to-day.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting Held January 9, 1924

The President, DR EUGENE H POOL, in the Chair

TOTAL AVULSION OF THE SCALP

DR CLARENCE A McWILLIAMS read a paper upon the proper treatment of total avulsion of the scalp with remarks on Thiersch and free, full-thickness skin grafts and pedicled skin flaps

DR ALBERT S MORROW said that He considered this work most discouraging, one is constantly meeting failure or only partial successes having to do the grafting over and over again He had one case, first seen last March, on whom he was about to reoperate for the eighteenth time These cases require an immense amount of patience on the part of the operator and very full cooperation on the part of the patient As to the Thiersch graft he had never had any good results from free, full-thickness skin grafts, though this might be due to his not having selected his cases properly, the circulation in the surface grafted not being as good as it should have been Most of his own experience had been with pedicled grafts and he had found that the long pedicle grafts could not be cut loose at the first operation or they would slough promptly, they should be left in place for ten days or two weeks and then cut loose and sewn in place

DR CARL G BURDICK said that he considered it better to leave both ends of a tubed pedicle graft attached for at least ten days He felt that the method of after-treatment in skin grafting was of considerable importance On the Children's Surgical Service at Bellevue they covered the grafts with paraffin mesh gauze, and employed the Carrel-Dakin technic over the mesh This promoted the absorption of the discharge, especially if it was impossible to entirely cover the granulating area with grafts

As regards cases of contracture of the axilla, the difficult point to obtain was the apex of the axilla In two cases which he had operated he had employed a method suggested by Doctor Abbe, which consisted of a tubed pedicle with epithelium on the inside of the tube This perforated the web at the point where the apex of the axilla was to be formed After the graft had taken, the web was divided and the resulting denuded areas covered either by a full thickness or a Thiersch graft

DR ROBERT T MORRIS said that the cutting of a strip of skin several days in advance of its transplantation, had larger significance than the simple point of giving opportunity to determine if any sloughing was to occur at

the margins. A much more important principle rested in the fact that a certain polarity of repair materials, carried them in excess to the strip of skin which was in the midst of physiologic processes of repair by the time for its transplantation. This point is demonstrated in some experimental grafting work with plants belonging to species that are grafted with difficulty. If one turns up a strip of a bark carrying a bud, then replaces the strip and waits for a week, transplanting of the graft may be successfully accomplished, in cases in which it would otherwise have been a failure. It is a protoplasm question and a physiologic repair material question which applies to all organic life.

Another point that Doctor Morris wished to make was the advantage of employment of scrotal tissues for full thickness grafts when such material was available for any given case. It was his belief that Doctor Dawbarn had first made this suggestion many years ago, but Doctor Morris had found it to be valuable in practical application.

DR CHARLES GORDON HEYD said that in cases of contracture of the neck it had been his experience that there was usually considerable scar tissue or fibrosis in the muscles and that even if normal skin were transplanted there was a great possibility of contracture. He then reported a case of complete avulsion of the scalp which in every way paralleled the case of Doctor McWilliams. The scalp had been avulsed by machinery, it had been sutured back on the head and sloughed. The patient was admitted to the Post-graduate Hospital, 103 days after her injury. She had a complete grafting of the whole scalp in 186 days. They had employed 12 autodermic Thiersch grafts, 6 autodermic whole-thickness grafts and 6 isodermic whole-thickness grafts. Doctor Heyd believed that one of the isodermic grafts had been successful. All the Thiersch grafts took.

DR JAMES M. WORCESTER said that the use for a full thickness graft was in a place where one wanted to avoid fibrosis and if it is successful it will be more advantageous than a Thiersch graft. But if the place is where one has to excise scar tissue, particularly the fingers, it is impossible to get a base of normal tissue. It is decidedly limited in its application.

DR HUGH AUCHINCLOSS said that he remembered Doctor McWilliams about ten years ago removing a piece of skin and subcutaneous tissue and putting it in a bottle of sterile salt solution where it remained at room temperature, in the House Surgeon's room, over night. The next morning, on learning that there was a case to be grafted in the Out-service Department, he suggested that this piece of skin be used. He made a Thiersch graft from it and used it on a patient that same day. It took and remained all right. Sometimes they did take, though more often not. About X-ray burns, Doctor Porter, of Boston, had treated many of those and reported something like 20 or 30 cases several years ago. Many of these cases were successfully treated by excision and Thiersch grafts. In the experience of the speaker during the past ten years, some of epitheliomata and some of purely granulating areas on the back of the hand, the fingers and nails,

RESULTS OF TREATMENT FOR FRACTURE OF NECK OF FEMUR

it was astonishing how, when the ulcerating area had been excised and the graft put on, practically every graft took, whether there were infection or not, and the immediate relief from pain and discomfort was very gratifying. As to the full thickness graft, for the past two or three years the speaker has used this in the radical operation for carcinoma of the breast. At some point in the margin of the wound flaps there is generally reduplication of skin. This excess is cut away, the fat completely trimmed off with blunt scissors and the graft simply placed on the chest wall and retained by accurately placed bits of gauze fastened by sterile adhesive strips. Some parts of the graft and in many the whole graft, has taken in every one of those cases. He was convinced of the usefulness of this procedure. As to the transplant of hair to the eyebrow, the double pedunculated transplant, first to the arm and then to the forehead, might be useful.

Stated Meeting Held January 23, 1924

The President, DR. EUGENE H. POOL, in the Chair

RESULTS OF TREATMENT FOR FRACTURE OF THE NECK OF THE FEMUR (FOUR CASES)

DR. ROYAL WHITMAN presented four patients treated by the abduction method for fracture of the neck of the femur to show functional recovery.

1. A woman of seventy-three years of age, treated in 1921, for subcapital fracture.

2. A man sixty-eight years of age, treated in May, 1923, for extracapsular fracture with avulsion of the trochanter minor and splitting of the shaft.

3. A man fifty-five years of age, treated in 1917, for intracapsular fracture.

4. A woman fifty-three years of age, treated in 1921, for intracapsular fracture.

All of the patients walked without a limp.

Doctor Whitman said he presented these patients particularly to illustrate functional recovery which was still generally supposed to be impossible. Indeed, according to a leading treatise on fractures, "Restoration of form and function was rarely to be attempted or even sought in treatment."

It might be recalled that at a recent meeting, one of the members had apparently failed to recognize the comprehensive effectiveness of the abduction treatment, since he had mentioned as practicable alternative artificial impaction, the insertion of metal screws, primary excision of the head of the femur and primary autogenous bone pegging. He thought the last of these was the only one that merited serious consideration, but even admitting that the bone graft might induce union which would not have followed secure apposition, the number of cases in which such an operation would be either advisable or practicable was insignificant. It might be noted furthermore that accepting the results as representative of an operation evidently skilfully performed

and in which union had been attained the results in comparison with those presented this evening are far inferior, since in all instances the limp was pronounced and joint motion restricted by residual deformity

DR JOSEPH A BLAKE said that he did not agree with Doctor Whitman in one respect and that was that he had seen good results follow the use of Doctor Whitman's method, by men who applied it without his (Doctor Whitman's) personal instructions. The speaker had counselled its employment for nearly every case of fracture of the neck of the femur that he had seen. He considered the results that had been obtained in old cases were remarkable, and in recent cases union took place in the normal time for an ordinary fracture.

DOCTOR WHITMAN rejoined that the chief obstacle to progress had been the teaching embalmed in the text-books, that fracture of the neck of the femur was an exception to all other fractures in that its treatment on surgical principles, even if practicable, was both hazardous and futile. Consequently there had been no standard to which an advocate of efficiency might appeal nor official recognition of the fact that there could be but one effective treatment of the fracture because there was but one method adapted to the anatomical construction of the injured part. He thought now that faith in conventional authority to assure immunity for inefficiency and neglect had been shaken, that the chief deterrent to the general adoption of the abduction treatment was lack of training for a method that required beside a certain understanding of mechanics and anatomical topography the adjustment of a secure and comfortable plaster splint. In fact, he had rarely seen these conditions fulfilled except by those who had come directly or indirectly under his personal supervision. He thought, therefore, that the good results reported by others who employed the principles of the abduction method with variations in its application of which he did not approve, were the strongest evidence in favor of its inherent superiority and effectiveness.

PROGRESSIVE FIBRINO-PURULENT PERITONITIS

DR WALTON MARTIN presented a man fifty-four years old, who was admitted to St. Luke's Hospital in June, 1918. On admission a distinct mass could be felt to the left of the median line and just below the level of the navel. His temperature was 102, his pulse was rapid, he looked septic. His illness had begun three weeks previously. While sitting reading at about ten o'clock in the evening he was suddenly seized with violent epigastric pain. He caused himself to vomit by taking large quantities of warm water but obtained no relief. The pain continued during the night, confined to the epigastrium and not radiating to the back or toward the lower abdomen. At one o'clock he called his physician, who had been treating him for diabetes for the past six months, and his regular family physician, but did not see either until the next morning, twelve hours after the onset of his trouble. The physicians disagreed, one wished to have an immediate operation, believing that he was suffering from appendicitis and peritonitis, the other advising against operation and attributing his pain to cholecystitis.

During the next two days he grew worse, the abdomen became somewhat distended, his temperature varied between 101 and 104, his pulse became very

LATE ABSCESS FOLLOWING APPENDICITIS

rapid. The extremities were cold and the surface circulation was poor. He did not continue to vomit, he passed gas by the bowel. The pain continued in the upper abdomen. Several physicians had been called to see him. A well-known consultant who saw him on the fourth day of his illness said that he had general peritonitis, that he only had a few hours to live, and that it was too late for surgical interference.

Doctor Martin saw him at this time and felt so uncertain as to the situation of the focus of infection and so convinced of the gravity of his condition and the danger of doing an exploratory operation that he advised waiting. The patient gradually grew better and a mass and local tenderness made their appearance beneath the middle of the left rectus and he was sent to St. Luke's Hospital. At operation, on cutting through the abdominal wall over the mass, several ounces of foul-smelling pus welled up into the wound.

He left the hospital in eight weeks, the discharge had ceased, the wound had closed. He did not, however, regain his health. The following autumn he again had temperature every afternoon and a mass gradually formed in the lower right quadrant. He was admitted to the hospital and two intra-abdominal abscesses were opened, one through the lower right rectus and the other laterally near the crest of the ilium. They apparently did not communicate. His wounds closed but he continued in poor health. From time to time he had attacks of pain and several times a febrile reaction. A small hernia formed in the scar through the right rectus.

In the end of November 1919, eighteen months after his original attack, the abdomen was opened, the cæcum identified, the appendix dissected out of a mass of dense adhesions and removed. It showed chronic inflammation and had apparently ruptured at one point. The abdominal wall was repaired. The patient made a good recovery. He has had no abdominal symptoms since and, except for his diabetes which is controlled by restriction of diet, is well.

The case report seemed to Doctor Martin of interest, first, because the patient recovered from a general peritonitis without the removal of the original focus of infection, second, because he presented a variety of peritonitis in which local abscesses are formed one after another in various parts of the peritoneum, the walling in of the infection seeming to be incomplete and the infection slowly spreading from point to point.

If the advice of the physician who first saw him had been taken, he would have escaped a prolonged illness and much suffering.

LATE ABSCESS FOLLOWING APPENDICITIS

DR WALTON MARTIN presented a young man twenty-five years old, who had been referred to him five years ago for pain in the right side and hip. He was in poor health. He had no temperature, there was no restriction of motion in the joint, there was no local tenderness. An abscess had formed about a month previously in an old scar, the site of an operation done when he was two years old. It had opened and drained. The scar was situated in the right lower quadrant of the abdomen.

An X-ray plate was taken of the right iliac region and hip. The bone was normal but there was a shadow of a large pin in the right inguinal region beneath the old scar (Fig. 1).

The scar was incised and a small tract lined with granulations followed down. It led to a cavity containing a small amount of foul pus and a large rusty pin embedded in fecal concretions. The pin was removed and the abscess cavity drained. The wound closed but three times during the next three years, there was pain and tenderness in the region of the scar, and the

abscess was reopened, discharging each time a small amount of foul-smelling pus

In May 1923, the cicatrix was excised, the abdomen opened, the cæcum and appendix identified and delivered from the wound. The sinus wall and the appendix were removed and the abdomen closed. He made a good recovery and has remained well. The sinus led to a hole in the appendix.

During infancy the boy had evidently had an acute appendicitis with a circumscribed abscess and a foreign body which had escaped from the appendix into the abscess cavity. The abscess had been incised and the foreign body and the small cavity had remained for fifteen years, causing attacks of

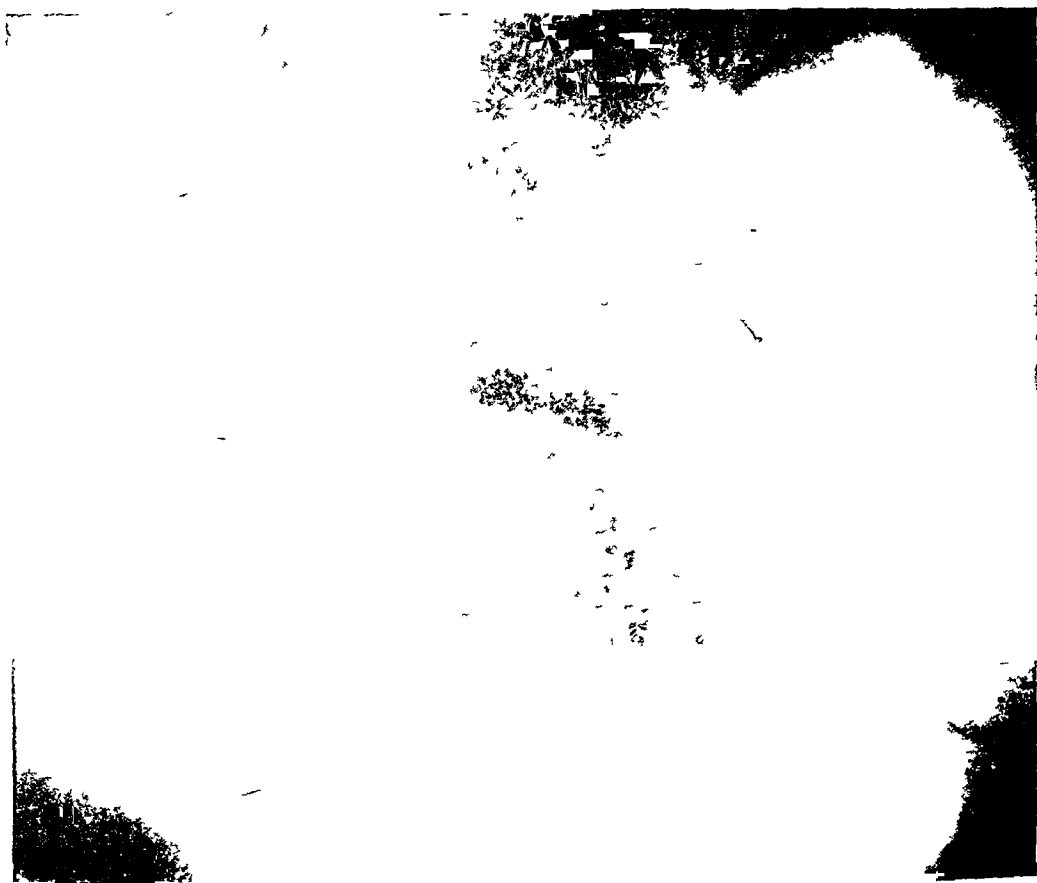


FIG. 1.—Appendiceal abscess containing a pin which was removed sixteen years after the original infection (Walton Martin)

pain referred to the side and hip. Probably the cavity incompletely drained through the appendix.

Doctor Martin presented also a man forty-three years old, who was admitted to St. Luke's Hospital in April, 1923. On admission the patient looked ill and septic. He had been unable to work for five months, much of the time being in bed. He had pain and tenderness in the right lumbar region, had no appetite and had lost forty pounds in weight. He had had four or five attacks of very severe pain in the lower right lumbar region, there had been no chills and no urinary symptoms. He had never been ill before.

Examination showed a large, swollen area slightly red and very tender just above the posterior half of the crest of the ilium. The temperature on

HIGH ENTEROSTOMY FOR ILEUS

admission was 102 and the pulse rate 114. X-ray and cystoscopic examinations were negative.

On April 4 an abscess containing much pus with a foul odor was opened and drained through an incision just above the crest of the ilium. The finger passed into a large cavity which extended over the crest of the ilium into the iliac fossa. The abscess was evidently extra-peritoneal. The man improved but continued to have evening temperature and the incision contracted down to a discharging sinus.

In June, 1923, believing that the abscess must have originated in the appendix, the abdomen was opened through an intermuscular incision. The cæcum was identified and the base of the appendix isolated. The appendix was divided near its base and removed. It was largely retrocæcal, the end had sloughed and a probe passed into the lumen appeared in the abscess cavity history of appendicitis. The case was evidently one of "appendicitis ileo-inguinalis subfascialis," which had burst through the iliac fascia and passed out over the crest instead of working downward under Poupart's ligament.

HIGH ENTEROSTOMY FOR ILEUS JEJUNOSTOMY

DR SEWARD ERDMAN presented a man, aged sixty years, who was admitted to the Second Surgical Division of the New York Hospital, on September 23, 1921, with symptoms of ileus complicating a ruptured appendix abscess. For two weeks he had been sick at home and in bed. The onset had been with general abdominal pain, nausea and diarrhoea and vomiting. After the first 24 hours the pain localized in the right lower quadrant and persisted in that area for six days. Five days before admission, although the local pain was less and he had not vomited since the second day of his illness, vomiting recurred and persisted. His physician says that the vomitus has become fecaloid and for past 36 hours there has been no passage of feces nor gas.

On admission there presented a poorly nourished man, markedly prostrated and desiccated, who appeared almost *in extremis*. There was regurgitant vomitus of dark brown fecaloid material. The temperature was 102, the leucocytes 27,000, with 88 per cent polymorphonuclears, the pulse and respirations were very rapid. The abdomen was much distended and rigid with tenderness over all but maximum in the right lower quadrant. Operation was at once performed after gastric lavage.

As the symptoms of ileus predominated the picture, it was decided to perform a jejunostomy at the same time that the appendix abscess was drained. (a) Under gas anæsthesia, a MacBurney incision was made and an abscess about the cæcum containing three ounces of thick pus was opened. The appendix could not be readily felt and was not searched for. (b) An incision was now made above and to the left of the umbilicus and a jejunostomy performed by the Witzel method, using a No. 18 French catheter with end and side openings. The intestines in this upper left quadrant were distended and very red and bathed in turbid fluid. Upon inserting the tube into the jejunum, about 700 c.c. of foul-smelling brown fluid and considerable flatus was expelled.

Post-operative Notes. For three days there was profuse drainage of about 1500 c.c. per day. On the second day and thereafter there occurred small liquid involuntary stools. The tube was removed on the fourth day with only very slight leakage for two days more. After the operation the distention was at once appreciably diminished, the patient was much more comfortable and there was absolutely no recurrence of the vomiting. A fecal

fistula in the appendix wound discharged from the fourth to the seventeenth day. The man was discharged on the twenty-fifth day after operation.

Although a direct result of the spread of the peritonitis from the appendicitis, the ileus in this case, which did not manifest itself until the seventh day of his illness, was probably of the mechanical variety, the type in which jejunostomy is almost uniformly successful.

DOCTOR ERDMAN presented also a colored boy, aged twelve years, who was admitted to the same division of the New York Hospital on September 12, 1922, and discharged on September 25, 1922. The history of appendicitis was of three days' duration with very persistent vomiting. On admission he was acutely ill with temperature 104.4, pulse 124, leucocytes 9600, with 85 per cent polymorphonuclears. The abdomen was much distended, rigid, and tender over all.

An immediate appendectomy was performed and a gangrenous appendix without any walling off was found together with a large amount of free purulent fluid. The operator, Doctor Dineen, decided that an immediate jejunostomy was indicated for relief of paralytic ileus, and this operation was performed at once, the bowel was red and distended. A small quantity of bile-stained fecaloid material was obtained on introducing the tube.

During the first post-operative day a large amount of discharge occurred (amount not measured), 1150 c.c. on the second day, 850 on the third and only 30 c.c. on the fourth. On the fourth day a good evacuation was accomplished after pituitrin and a colon irrigation. The tube was removed on the fifth day followed by no appreciable leakage. The patient was discharged on the thirteenth day after operation.

Two months later (November 19, 1922,) he was given a barium meal, but the X-rays did not reveal any abnormality adhesions or deformity of the tract.

Either this case represents a rather remarkable benefit due to an early jejunostomy for paralytic ileus of general peritonitis, or one may feel that the boy would have recovered without this procedure.

ACUTE DIFFUSE PERITONITIS OF UNDETERMINED ETIOLOGY THREE YEARS AFTER ACUTE PANCREATITIS

DR. ALLEN O. WHIPPIL presented a woman, who was fifty-three years of age on admission, in January 1919, to the Presbyterian Hospital, with the history that eighteen hours before admission she was suddenly awakened with a very severe, sharp pain in the left upper quadrant of the abdomen. This quickly spread through the abdomen, becoming generalized and centring in the region of the umbilicus. She vomited first nine hours before admission and twice afterwards. Bowels had failed to move for fifteen hours before admission. She had noted tenderness in the abdomen from the onset of the attack but had no respiratory, cardiac or renal symptoms.

Past History—Nine years previously she had had a severe attack of pain in the right upper quadrant associated with jaundice. At that time she passed three faceted stones. One year later, that is eight years previously, she had a similar attack and passed three more stones. In the interval of eight years she had had no symptoms of acute pain or interval digestive disturbances. Has had two children, no miscarriages. Bowels have been constipated. Never had typhoid.

On admission temperature was 101.4, pulse 96, respirations 22. She was pale, somewhat anæmic, had a suggestion of icterus in the sclerae. Tongue was dry coated. Throat negative and chest was negative. Abdomen was distended, showed a wide costal angle. There was acute deep tenderness

ACUTE DIFFUSE PERITONITIS

over the entire right side and especially over the epigastrium and right upper quadrant, there was distinct rebound tenderness at the umbilicus. Rigidity was present in both quadrants on the right side, less on the left. Respiratory movements were splinted. Pelvic examination was negative. White blood-cells 12,300, polymorphonuclears 90 per cent, blood sugar was 1.4 grams per litre. Wassermann negative. Because of her previous history and the acute signs over the right side of the abdomen, ante-operative diagnosis of acute cholecystitis with diffuse peritonitis was made.

Under drop ether anaesthesia, a right rectus incision was made. There was a large amount of turbid bile-stained fluid in the right side of the abdomen, in the pelvis and left lower quadrant. Large amounts of it were present in the retroperitoneal tissues on the right side both as free fluid and as oedema. Retroperitoneal tissues on the right side were soggy with oedema, in places 6 to 8 cm thick. Fat was bile-stained and in the right upper quadrant showed areas of fat necrosis. There was a general irritative peritonitis. The gall-bladder was not distended. It was only slightly thickened, and contained a thick, dark green bile. No stones were found on careful search. The gastro-hepatic omentum was so oedematous as to preclude definition of the common duct, duodenum and pylorus felt normal. The pancreas was enormously increased in size, having the feel and size of a clenched fist at the head. The process involved head, body and tail. The lesser sac was obliterated as a result of the increase in size of the pancreas and the oedema of the retroperitoneal tissues. Diagnosis of acute pancreatitis was based on the lesion of the pancreas and areas of fat necrosis. A cholecystostomy was done with drainage of the lesser sac through the gastro-hepatic omentum with a rolled cigarette drain. Culture of the fluid showed a non-haemolytic streptococcus.

The post-operative course was remarkably smooth. She made a rapid recovery. Followed up for five visits over a period of thirty-six months showing optimum anatomic, symptomatic and economic result that is 4 4 4.

Forty months after the operation she had an attack of epigastric pain, severe in character, radiating to both shoulders. This lasted for two hours, and she was jaundiced for one day. Two months later, that is forty-two months after the first operation, she came to the accident ward with the history that almost every week since attack two months ago she has had epigastric pain with considerable bloating and belching and has been constipated. The present attack started twenty-four hours ago and began with pain in left lumbar region, which passed around to epigastrium and radiated to both shoulders. Vomited three or four times. Bowels moved yesterday. No jaundice.

Physical Examination Rather obese, color good, no jaundice. Temperature 99.8, pulse 98, respirations 22, 15,000 polymorphonuclears (94 per cent). Blood-pressure 118/64. Her abdomen was distended, tender in all quadrants, but most marked in left upper quadrant and epigastrium and left costo-vertebral angle. Rebound tenderness present. Rigidity present in all quadrants. No masses made out. No fluid was elicited. No loss of liver dullness. An examiner made a diagnosis of acute pancreatitis. Blood urea 0.89 grams per litre. CO_2 52.2 vol per cent, chloroform anaesthesia.

Upon opening the abdomen the pancreas was felt normal in size and consistency. No fat necrosis seen. Gall-bladder felt normal in size, was not inflamed, although there were old adhesions about it from previous drainage. Duodenum and stomach normal. No perforation found. Appendix small, atrophic. Pelvic organs negative. No focus could be found to explain presence of sticky, purulent exudate in lower abdomen and the acutely congested gut throughout. Pus was odorless, thin, sero-purulent, yellowish.

Incision right para rectus Penrose tubes down to serosa Culture of pus, no growth Smears, Gram-positive cocci

Complications, none Drains all out by seventh day Home twenty-third day Forty-five and two months—4 4 4, 123 pounds Fifty-one and eight months, 4 4 4, 133 pounds No digestive disturbances Firm scars Fifty-three and ten months, 130 pounds No indigestion General condition excellent No attacks of pain Px General appearance good Reaffirms the passage of gall-stones

DR RICHARD LEWISOHN said it was possible these attacks might have been caused by stones higher up in the hepatic ducts, which when coming down caused jaundice and other severe symptoms with secondary infection He showed before this Society a few years ago a man operated on eight years previously for intra-hepatic stones which had come to the surface and which he cut out from the surface of the liver This patient was afterward readmitted to Beth Israel Hospital as an emergency case and operated on by Doctor Isaacs who found a large abscess in the upper abdomen with localized peritonitis between the liver, the pancreas and the stomach As no cause could be determined for the abscess, simple drainage was instituted The man made an uneventful recovery Doctor Whipple's case might be of similar nature

DR JOSEPH A BLAKE asked Doctor Whipple if he was sure this was not a pneumococcic peritonitis, and if he had examined the Fallopian tubes

DOCTOR WHIPPLE replied to Doctor Blake's question that the pelvis was carefully palpated and the tubes felt normal The uterus was atrophic and the tubes felt thin and normal Smears from the pus showed a chain type of coccus, and though there were signs of a questionable pulmonary condition the patient did not develop a pneumonia and the physical signs cleared up after operation The tubes had been thought of as the source of the infection, but the smears looked like streptococcus rather than pneumococcus

In reply to Doctor Lewisohn, he feared he had given a wrong impression, the pus was not in the upper but in the lower abdomen and suggested the condition Doctor Blake had mentioned At the first and second operations the patient had diffuse peritonitis The first was of the irritative type, and it seemed to him the less one did in those acute irritative peritonides associated with pancreatitis, the better, simply letting out the fluid was better than to attempt anything further If the source of the infection were acute cholecystitis, then the focus should be drained or removed

THE TREATMENT OF SUPPURATIVE PERITONITIS

DR JOSEPH A BLAKE read a paper with the above title, for which see the ANNALS OF SURGERY for May, 1924

DR WALTON MARTIN said that when he had the pleasure of working with Doctor Blake he always felt that he (Doctor Blake) was attempting to get a very definite idea of the pathology first and then work out a rational treatment He then was using the two-way irrigator, as he had said At that time there was a very large emergency service at Roosevelt Hospital and

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there were many cases of perforation in the gastro-intestinal tract, pathological and traumatic. The double current irrigator introduced through a small abdominal wound was certainly an effective method of removing mechanically foreign bodies such as food particles and fæces. Doctor Martin said that he remembered a fragment of lettuce leaf washed out of the pelvis after a gastric perforation. It was his impression that patients came to operation later twenty years ago than they do now and as there is the well-known relation between the time interval between perforation and operation and the results, it is difficult, it seemed to him, to make comparison of methods of treatment. He thought, however, that to-day when there is much less irrigation used there are possibly fewer residual abscesses, but the mortality is still largely determined by the removal of the focus of infection before the peritoneal contamination has lasted for more than a few hours. Different methods of treatment of the peritoneum seem to give fairly satisfactory results in perforations operated on and closed within twelve hours and none seem to give satisfactory results after twenty-four or forty-eight hours. The speedy recognition and removal of the focus, he thought, is to-day generally recognized as the essential point. Whether or not when the irrigator was introduced into all quadrants of the abdomen in the early cases and cloudy exudate removed, we were not actually removing a protective fluid furnished by the peritoneal cells is a question.

DOCTOR MARTIN remembered when Doctor Blake read his original paper advising against the attempt to drain the general peritoneal cavity, he was annoyed by his teaching being misinterpreted and being called in to see patients in whom well-marked circumscribed peritoneal abscesses had been opened, washed and then immediately closed with most unsatisfactory results. Circumscribed collections of pus should be drained. It is impossible to drain the general peritoneal cavity and Doctor Martin thought the timely work that Doctor Blake and a number of other surgeons did twenty years ago, in bringing out the fact that the effort to drain not only was useless, but distinctly harmful, was most important.

DR ALLEN O WHIPPLE said the instruction as now given in the third and fourth-year surgical courses at the College of Physicians and Surgeons, as regards the treatment of peritonitis, shows a close adherence to the principles that Doctor Blake proposed in his former contributions. The students are given the following dictum: "Early diagnosis of peritonitis with an accurate diagnosis of the initial focus or portal of infection, early operation by a competent surgeon, with nothing more than a rapid removal of the focus or closure of the portal of infection with or without proper drainage, and finally the correct post-operative care, are the cardinal factors in the therapy of acute peritonitis." "As regards drainage, no hard or fast rule can be given, but it may be stated that if the focus of infection is removed, drainage should not be used unless any one part of the peritoneum appears more definitely damaged than another part. Stated in other terms, drain to and when (a) a part of the peritoneum shows necrosis or probable necrosis as

evidenced by fibrino-purulent adhesions, (b) the focus of infection has not been removed, or closure of the perforation has been unsatisfactory, (c) there is bleeding or oozing at the site of removal of the focus "

DR FRANZ TOREK said that on the occasion of Doctor Blake reading a paper on this subject about twenty years ago, before the Academy of Medicine, when the reader advocated the use of the double current irrigating tube, he took part in the discussion and described his method of managing the cases of widely diffused suppurative peritonitis of appendiceal origin, usually called general peritonitis, by a large incision, thorough but gentle lavage, and closure without drainage. His method remained the same to-day. At that time he had given his experience with diffuse suppurative peritonitis, meaning very far-spreading peritonitis that involved the left half as well as the right. He had then had eight cases without a death. The method consisted of making an opening in the median line extending from the pubes to some distance above the umbilicus, removal of the focus of infection, and cleaning the peritoneal cavity by lavage with saline solution. Doctor Blake had issued a warning against being excessively rough and thorough, but the speaker believed one should not mix those two conceptions, one may be exceedingly thorough without being in the least rough. The peritoneal cavity should be cleaned out with the greatest gentleness possible and the fluid rocked about with the gloved hand. Doctor Torek had published two sets of cases, totaling 36 in number of which 6 died, a mortality of $16\frac{2}{3}$ per cent. The second series was published in 1908, and since then he had not gathered his statistics but was sure they were no worse. Among the things he brought out at that discussion in 1904 was the statement that he closed the peritoneal cavity completely, without drainage. At that time such a procedure was considered rank heresy, when many surgeons were in the habit of draining even after clean abdominal operations, such as hysterectomy, gastro-enterostomy, and the like. But to close after an operation for a suppurative process seemed nonsensical. The Fowler position was then in vogue and Doctor Blake also had expressed himself in favor of the Fowler position with drainage in the pelvis. The speaker had then pointed out that drainage into the pelvis by gravity was a delusion. A large amount of pus might be caused to flow down by gravity, if not impeded by adhesions, but a sprinkling of freshly formed pus, such as might happen after a cleaning of the peritoneum, will not be influenced by gravity to run into the pelvis, and it was for that reason that the speaker had said it was impossible to drain the peritoneum through the pelvis. Doctor Torek said he wanted to impress the fact that a wide open wound did not mean roughness. If there were a large, wide opening, the intestines could be handled more gently than by introducing a tube through a small opening. Extreme gentleness was indicated. Wiping the peritoneum was bad, as it was apt to cause traumatism. Pus could be removed from secreted spots by lavage aided by a gentle motion of the hand. Injury to the peritoneum should be avoided, so that it may not lose its power to combat infection.

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DR ROBERT T. MORRIS said that the points made in the discussion might be classified clearly in two separate categories

Extensive drainage of the abdomen and free handling of bowel, together with the employment of large openings, belong to the third era of surgery. In that era, the dominant idea was that the surgeon himself should remove bacteria and their by-products regardless of any injury that he might cause the patient when doing this work conscientiously.

The paper of Doctor Blake dealt with features of the fourth era or physiologic era in which dependence is placed upon the patient's own protective resources. Ochsner's starvation method belonged in that group, but in addition to the Ochsner plan Doctor Morris agreed with Doctor Blake that a five-minute operation with superficial drainage constituted an improvement in Ochsner's technic.

DOCTOR MORRIS said that he did not believe that large incisions or extensive methods of flushing or cleansing the peritoneal cavity could be conducted gently. The nearer that a surgeon came to leaving a patient to his own resources, the more nearly he was in accord with the principles of the fourth era of surgery which Doctor Blake had included in the paper of the evening.

DR JOSEPH WIENER said there seemed to be a general agreement that traumatism in peritonitis was to be avoided. Time also was an important element if a general anæsthetic were used, but if the anæsthetic was eliminated the length of time occupied by the ordinary operation in these cases was of no importance to the patient. With local anæsthesia most of the disagreeable after-effects had been eliminated. When the speaker started using local anæsthesia he planned to use it in cases of peritonitis, and he had now a long list of peritonitis cases done under local anæsthesia. If eliminated the trauma to the internal organs, the kidneys, and lungs, which ether produced, and which local anæsthesia did not produce. It was astonishing in cases of peritonitis, so severe that the gentlest examination caused severe pain, an operation such as taking stones from the hepatic duct or removing a gangrened appendix could be done absolutely painlessly. Many lives had been saved by the abolition of general anæsthesia in operations for peritonitis.

DR HUGH AUCHINCLOSS said that during the years 1907-1908, as house surgeon, he had the opportunity of watching the cases Doctor Blake and Doctor Martin operated on for appendicitis at Roosevelt Hospital. They included most of the sorts and degrees of acute peritonitis with appendicitis. There was but one death in five months. This was a woman who had been under observation for a supposed salpingitis elsewhere for four days. She had a large, distended appendix full of pus. This was removed, the abdominal condition subsided, her bowels moved, but ten days later she died of sepsis. An indication of the fact that there was no scarcity of cases in this series will be seen by the number of these patients, seventeen cases were admitted to Doctor Blake's division to one case on the opposite division during the first part of the five months. They were all dealt with according to the principles outlined by Doctor Blake in his paper a few years previously.

He retained a most vivid impression of a young man brought in about six hours after the onset of acute symptoms. His abdomen was opened by a McBurney incision and real, creamy white pus was removed in considerable amount from the pelvis. To his astonishment the wound was closed tightly by Doctor Blake and uninterrupted convalescence followed with no subsequent infection. That was sixteen years ago and illustrates clearly the faith Doctor Blake has had in the principle that if peritoneal necrosis had not occurred, as in this case as well as in many an early case of perforated gastric ulcer, there had not been sufficient time for such a thing to take place, the indication lay in removal of the cause and avoidance of drainage necrosis.

DR F T VAN BEUREN wondered what rule Doctor Blake used in deciding whether to do an ileostomy or a jejunostomy. He himself had seen striking cases where unexpected improvement had occurred after enterostomy and he had wondered whether it was due to the jejunostomy or not. Those who had had the advantage of working with Doctor Blake at different times had many things to thank him for, but the thing that had helped the speaker most was the rule of Doctor Blake's, that when he operated on any case he first had a definite idea of the pathology—made a definite plan for procedure beforehand—and so saved time.

DR EUGENE H POOL considered that in the discussion of the paper a disproportionate emphasis had been put upon the subject of irrigation of the abdominal cavity. One speaker had said that he regularly flushes out the peritoneal cavity in spreading peritonitis. Doctor Pool's own feeling is that there are very rarely indications to irrigate the peritoneal cavity and he was sure that it could not be "washed out." Even with obvious contamination it is best not to attempt the process of irrigation. In regard to the question of ileostomy, on his service at the New York Hospital, the speaker said that a considerable number had been done for ileus following or associated with peritonitis, but only in cases that seemed hopeless. An independent incision was made and a catheter was introduced into a loop as high as possible. In a number of cases the result was phenomenal, the improvement was so rapid.

DOCTOR BLAKE, in closing the discussion, answered Doctor Van Beuren's query as to the rule in doing ileostomy, that if ileus has been present before the peritonitis, it was justifiable to believe it would continue and increase. He confined ileostomy to those cases that he thought would not get well without it. It was difficult to lay down definite rules for these cases. One of the last which he remembered was a typhoid perforation with extensive contamination of twelve hours' duration. He closed the perforation and did an ileostomy in the centre of the distended loop. It is necessary in such cases to get the distended loop emptied, and if one got the impression that the loop would remain distended it was better to do an ileostomy. Doctor Blake believed ileostomy was indicated in cases of paralytic ileus following peritonitis and prevented many from becoming mechanical.

The speaker considered that Doctor Morris had hit the nail on the head long ago regarding the treatment of peritonitis, and believed surgeons owed

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much to him, much of his own work in making small incisions and eliminating drainage having been due to Doctor Morris' influence. In desperate cases the best thing to do was to remove the cause of infection and do little more.

In regard to Doctor Martin's point about the exudate being protective, he believed that this fluid contained toxins as well as antitoxins. But this purulent exudate was not an index of the extent of the infection. The peritoneum had power to absorb it so the mere presence of pus was not an indication for cleansing the peritoneum, though one should clean out necrotic material. Proper cleansing of the peritoneum was a limited operation, and Doctor Blake did not believe one should leave in foreign bodies. Doctor Pool had done excellent work overseas, and it was certain that he had not left any fragments of shell or clothing in the knee-joints he had treated and it was just as reasonable not to leave foreign material in the peritoneum. Washing out the peritoneum was a very simple matter, it was not necessary to explore the abdomen but merely to pour the cleansing material in. As to Doctor Wiener's remarks regarding local anæsthesia, the speaker was in accord with them, these patients had a much better chance of recovery with local anæsthesia. General anæsthesia does produce additional traumatism to the lungs and kidneys. But there are many cases in which the advantages of general anæsthesia outweigh its additional risk.

BOOK REVIEWS

OPERATIVE SURGERY By WARREN STONE BICKHAM, M D Six volumes, octavo, 6000 pages, 6378 illustrations Saunders Co , Philadelphia-London, 1924

The first three volumes of the six planned by the author have been offered for review The work presents an elaboration of the very excellent previous one-volume editions, covering the same subject in a much more compact form More interest is afforded the reader when it is realized that we have presented the personal and individual work of a single author, differing thus from practically all those systems of surgery which are the combined work of many collaborators

Its scope, as is definitely stated, is a consideration of the operative technic involved in the operations of general and special surgery The subject is divided into three major parts namely Part I, General Procedures Employed in Surgical Operations, Part II, General Operative Surgery, and, Part III, Special Operative Surgery

One is primarily impressed by the general excellence of the binding—the usable and convenient size of the volumes—the well calendered paper which in turn has allowed of excellent reproduction of the author's profuse illustrations, over six thousand in number, and a very legible text—rendering the terse facile descriptions of technic more easily appreciable Considerations of etiology, symptomatology pathology, complications, diagnosis and prognosis are properly omitted For these one is referred to the works on general surgery Part I, exhaustively considers the preparation for operations—the induction of anæsthesia by various agents and analgesia The conduction of operations and general operative technics, and not the least important, the after-care of operated patients, all of these subjects are taken up in minute detail, all phases are well and instructively illustrated, and readably presented, constituting three hundred fifty-one (351) pages of text

Part II, on General Operative Surgery, incorporates many of the lessons learned during the past few years at so great a cost Thus, the subject of skin-grafting and the general principles of reformatory, reconstructive or plastic surgery and dermoplasty is particularly instructive and well presented These chapters are followed by three which deserve especial mention, as they represent phases of orthopædic activity to which too little attention has been given in contemporary works, but which, owing chiefly to the tens of thousands of maimed cases we have to care for at the present time, should be given much greater prominence Much information, therefore, may be gleaned from the author's presentation of the practical use of hydrocarbon prostheses, while his authoritative and original interest in cineplastic amputations and cinematic prostheses is well known and deservedly recognized An interesting chapter is devoted to artificial limbs, their various types, indications for use

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and the general features of their adjustment, a matter which should be much more earnestly considered by the higher class surgeon and in which he should collaborate more closely with the mechanic, instead of delegating the matter entirely to the latter. All of the above work is freely illustrated and the text thus amplified where it is most needed.

The second volume contains the descriptive technic of operative surgery upon the blood and lymph vessels, nerves, bones, muscles, cartilages, fascia, etc., and includes the special operative surgery upon the skull, brain, spine and spinal cord.

The author has designated the various operations by considering first, the surgical description of the special operative technic, second, by the anatomical designation of the structures involved, and last, the name of the deviser of the operation. In dealing with each group of tissues or class of operation or individual organ, we note the definite arrangement of first, the outline of the surgical anatomy of the region or organ, second, the surface form and landmarks, and third, the general surgical considerations involved, all of which are prefatory to the succeeding specific operations, each of which is introduced by its descriptive title, followed by the necessary preparation of the patient and operation site, the position of the patient, etc., landmarks, incision, detail of steps in operation and comments.

The third volume deals with operative procedure on a multiplicity of organs, as the eyes, ears, nose, neck, tongue, thyroid, breast, chest, etc.

The general scheme as indicated above continues to be systematically carried out. The plastic nature of much of the operative work involved, naturally necessitates elaborate illustration, which has been ably accomplished. To be noted particularly are the details of the various methods of rhinoplasty, cheiloplasty and stomatoplasty. The details of tubular flaps are not, however, noted, one wishes that this method might have been shown. The procedures of sliding or swinging are excellently portrayed, however. The omission of oesophagectomy for cancer of the thoracic portion of the oesophagus, which has been successfully accomplished, is also noted, its description would have enhanced the value of the chapter devoted to this subject.

The three volumes above reviewed are therefore worthy of much commendation. The amount of knowledge they impart, the methodical and concise manner of presentation and the profuseness and excellence of illustration, leave little to be desired. We hope, and feel confident that the remainder of the work will prove equally satisfactory.

JAMES T. PILCHER

HERNIA. By LEIGH F. WATSON, M.D., Associate in Surgery, Rush Medical College, Chicago, Ill. Large 8vo, 660 pages, cloth. St. Louis, C. V. Mosby Company, 1924.

THE preparation of this book has extended over a period of four years and the author has endeavored to present, within a reasonable space, the most important features of the anatomy, symptoms, diagnosis, prognosis and

the best modern operative technic of hernia. The entire subject has been exhaustively treated. It will seldom be necessary to look further for any information, but for those who desire to make deeper investigations there has been added at the close of each chapter an extensive bibliography. The recent renewal of interest in the subject of hernia, especially from the standpoint of permanent cure, makes the publication of this book a timely one. We wish that every physician could read the section on the Dangers of Taxis in Strangulated Hernia. There are thirteen mentioned and they seem very real to the reviewer who, recently during an operation for strangulated hernia saw a loop of discolored, ecchymotic intestines which had been damaged by an attempt at reduction of one hour's duration.

Twenty-seven pages are devoted to the Anatomy of Inguinal Hernia "to render unnecessary a search through the more exhaustive treatises devoted exclusively to anatomy." The various drugs used to produce local anæsthesia are described and there are many illustrations showing the methods of administration—step by step.

It would be difficult to find any method of operative treatment of inguinal hernia, or any little modification in technic advocated by anyone that is not mentioned and clearly described or depicted. As an illustration, in discussing the disposition of the sac the preferences of thirty-six different men are mentioned. The Modified Bassini, Halsted, Ferguson, and Andrews operations are beautifully shown and the Author's, LaRoque's, Stetten's and Scott's modifications are also sketched, while seven others are described. Six methods for the treatment of direct hernia are illustrated. This section on Inguinal Hernia is followed by a bibliography of seven pages.

The illustrations of the operation for Umbilical Hernia in adults are unusually numerous, large and clear. The more rare hernias, such as Lumbar, Obturator, Perineal, Sciatic and Diaphragmatic receive suitable space. The section on Internal Hernia is very interesting and well worthy of perusal by any surgeon. An especial word of commendation should be given to the artist, W. C. Shepard, for the splendid drawings which show the most painstaking care.

The book ends with a chapter on the Medico-legal Aspects of Hernia.

This volume may be used either as a text-book or for reference purposes. The author may well be proud of this production which shows so plainly the many long hours of study and the zeal of its creator.

HENRY F. GRAHAM

SELECTED ESSAYS ON ORTHOPÆDIC SURGERY. By NEWTON MELMAN SHAFER, M.D., with Forewords by Doctors Lovett and Fisher, and Comments by Doctors Cotton and Nutt and by Messrs. Blagden and Harden. G. P. Putnam's Sons, New York and London, 1923.

When a recognized leader in any human endeavor writes on the subject of which he is master, the reading public takes notice, when that leader is a specialist in one of the fields of surgery and gives forth the fruits of years

BOOK REVIEWS

of thought and practice in that field, the profession realizes that a work is available which is a monument to that man's life. This is such a book.

Most of the chapters are reprints of lectures or essays on subjects given at various times during the long and useful life of the author. All of the essays are dated, they cover twenty-seven years from 1877 to 1904. The occasional footnotes, made by the author in 1923, increase the scope of the essays to forty-six years. The subjects treated in no sense comprise the field of Orthopædic Surgery as we understand it to-day. But forty to fifty years ago, there was almost bitter controversy over the subject of tuberculosis of joints, so a major part of the text treats in a masterly way such questions as the causes of deformity and how to combat them, should "cold abscesses" be opened and drained, the relative value of traction and non-weight-bearing as compared with fixation and weight-bearing, in hip-joint disease. Doctor Shaffer thought strongly on these questions, his conclusions were based on intensive study of his many cases in his large public and private practice, and they stand to-day as the best thought on these subjects. Other conditions discussed in this work are lateral curvature of the spine, club-foot, flat-foot, knock-knees and bow-legs, deranged semilunar cartilages and fracture of the neck of the femur. As he always gave preference to the use of apparatus over operative procedures, as he had a master's leadership in its use, so many of these essays are careful descriptions of the indications for and the detail in the use of apparatus.

The forewords are written with appreciation of the author and the comments record historical data in connection with the growth of two of the leading Orthopædic Hospitals of the country. The book is thoroughly illustrated and is attractively printed.

It is valuable to the medical student to-day as a record of one who has borne his share in the development of Orthopædic Surgery, whose contribution has been preeminent in the description and care of tuberculosis of joints, and in the use of apparatus. His mastery of the principles of mechanical treatment is worth careful study to-day. To one hoping to find a record of the marked advance in operative Orthopædic Surgery, which the past twenty-five years have developed, there will be disappointment. The author did not think in terms of operating and he has not followed this more recent development of his specialty.

WALTER TRUSLOW

CORRESPONDENCE

GASTRO-JEJUNO-COLIC FISTULA

EDITOR ANNALS OF SURGERY

Sir

In the ANNALS OF SURGERY, April, 1923, Pratt reported a case of gastro-colic fistula due to carcinoma, and considered 127 other cases gathered from the literature, and concluded from the material studied that in order of frequency the cause of this condition is to be found in "First, cancer, second, ulcer, third, following gastro-enterostomy, fourth, tuberculosis, and lastly, congenital anomalies" In the case here reported, marginal ulcer following gastro-enterostomy was the apparent etiological factor

CASE REPORT *History* The patient, an unmarried man, aged thirty-one, a Russian Jew, was referred to this hospital in January, 1923, by a physician in Harbin, Manchuria On admission he gave a history of an acute gastro-intestinal attack after a heavy meal in March, 1922 This attack was followed by a persistent diarrhoea with six to eight light brown liquid stools per day, and by frequent foul eructations He was examined in Harbin in October, 1922, and at that time the stomach examination revealed 30 c c of foul yellowish-gray material in the fasting stomach with no free hydrochloric acid, but with much lactic acid, many Oppler-Boas bacilli, starch granules and muscle fibres After a test meal, the findings were, HCl, 26, total acid, 43 Repeated lavage afforded some relief

Since 1908, the patient had suffered from epigastric pain coming on about three hours after eating The appendix was removed in 1915 through a McBurney incision The symptoms were not relieved, and a gastro-enterostomy was done in a large hospital in New York in 1918, when a diagnosis of duodenal ulcer was made A severe hemorrhage occurred two weeks after the operation, and the convalescence was prolonged and stormy Recovery was not complete, nevertheless the patient entered the army and was able to carry out the duties of camp life He was never free from his old pain, however, and was at one time treated medically in an army hospital for six weeks without relief Following the operation in 1918, the epigastric pain after meals recurred periodically, often being localized upon the left side, radiating downward to the left

The patient came to China, in May, 1919 In December of that year, his epigastric pain being so severe he had a stomach examination made in Harbin, the report being "very much acid and HCl" There has been little change in weight during the past five years

Examination showed the patient to be a moderately well-nourished man, weight 56 kilos The general physical examination was negative There was a small post-operative hernia in the right rectus incision The abdomen

was slightly distended and tympanic, and there was definite tenderness in the upper left quadrant above and to the left of the umbilicus. The fasting stomach contained a small amount of a grayish foul fluid showing no free HCl, but with a total acidity of 64. Following the test meal, free HCl was present for 45 minutes with readings of 62, 42 and 56 with corresponding total acidity readings of 82, 60 and 72. Free HCl disappeared in one hour. During the next hour the total acidity varied from 14 to 54. The specimens were taken every fifteen minutes through the Rehfuess tube.

Fluoroscopic examination showed no gastric residue after a six-hour meal. The gastro-enterostomy opening was patent, but a part of the opaque meal passed down the left side apparently into the sigmoid and rectum. When the barium reached this point the patient wished to defecate and the stool passed seemed to contain fresh barium. A barium enema was given after the gastrointestinal tract had been cleaned out and was seen to pass into the transverse colon and to fill the stomach at once. This observation was immediately confirmed by the recovery from the stomach of the barium enema through a stomach tube, and a chemical examination revealed unchanged barium. The routine laboratory findings were all within normal limits. A diagnosis of gastro-jejuno-colic fistula was made.

Operation January 26, 1923. Anæsthetic, ether. Iodine skin preparation. A high left rectus incision was made and the upper right quadrant was found filled with dense adhesions. These were dissected free until the pylorus was seen. The duodenum was so buried in adhesions that it was not thought advisable to attempt its isolation, and it was not possible to determine whether or not a duodenal ulcer was present at the time of operation. The transverse colon was closely bound to the greater curvature of the stomach and an opening from the stomach into the colon could be easily felt. The jejunum was attached to the posterior wall of the stomach 15 cm. distal to Treitz's ligament. The colon was attached very close to the site of the anastomosis between the jejunum and the stomach. The gastro-enterostomy opening was patent.

The transverse colon was freed from its attachment to the stomach and its lumen was opened as it was dissected away. It was found to communicate with the stomach and with both loops of the jejunum. The edges of the opening into the colon were indurated, but did not give the impression of malignancy. The opening into the colon was easily closed. The gastro-enterostomy was then taken down. Careful search was made for a marginal ulcer and for a malignant growth. Neither were found. The edges of the opening into the stomach and jejunum were excised and with a few adjacent lymph-glands the tissue saved for pathological examination. A new gastro-jejunosomy was made at the same site, the new opening being considerably larger than the old.

Post-operative Notes The convalescence was uneventful save for a superficial wound infection. Pathological examination of the tissue excised from the site of the old gastro-enterostomy showed chronic inflammation, the

lymph-glands were slightly hyperplastic, and there was no evidence whatever of malignancy

The patient was seen two months after discharge. At that time he was free from symptoms and had gained 6 kilos in weight. He returned to America at the end of March, 1923. A letter from him May 16, 1923, stated that the epigastric discomfort had recurred, and a further report June, 1923, stated that he had consulted a well-known surgeon in New York, who proposed another operation for marginal ulcer.

Discussion. The case here presented is one of duodenal ulcer with long-continued hyperacidity and ulcer pain. An ineffective appendectomy was done through a grid iron incision which did not admit of thorough exploration and discovery of the important lesion, and a subsequent gastro-enterostomy became necessary. Following the gastro-enterostomy, symptoms which may reasonably be ascribed to a marginal ulcer set in and continued with remission and exacerbations for four years. When these symptoms were most acute in the fall of 1919, an examination of stomach contents showed high HCl. The onset of the diarrhoea was very sudden, and a subsequent stomach examination showed high organic acid with no free HCl. The examinations made in this hospital revealed high HCl lasting less than one hour after the test meal.

It seems reasonable to suppose that a marginal ulcer set in after the gastro-enterostomy and continued until the gastro-jejuno-colic fistula was formed. This new opening allowed dilution of the HCl with healing of the ulcer, which, however, seems to have recurred after the closure of the colic fistula when conditions again became favorable for the action of a corrosive acid secretion upon the jejunal mucosa. At the operation done here, the stomach and jejunum should not have been reunited. A plastic operation should have been done on the pylorus with excision of the ulcer base in the duodenum and the gastro-intestinal tract should have been reestablished by a gastro-duodenostomy. The striking variation in the hydrochloric and organic acid obtained from the stomach during the existence of the opening into the colon may be explained by the rapid loss of stomach contents into the large bowel and by dilution by regurgitation of material from the colon. It is interesting that the marginal ulcer healed while the colic fistula was open, and promptly recurred upon its closure and reestablishment of the gastrojejunostomy.

ADRIAN S. TAYLOR, M.D.,
Peking, China

GANGRENE OF THE BREAST COMPLICATING DIABETES

EDITOR ANNALS OF SURGERY

Sir

Many investigators believe that there is a special tendency to vascular hypertension and arteriosclerosis in diabetic patients. Dry gangrene of the lower extremities is frequent when there are marked degenerative changes in the peripheral vascular system. In elderly patients the arteriosclerosis is fre-

CORRESPONDENCE

quently so marked that the vessels may readily be shown by X-ray. The circulatory disturbances are not necessarily in the same proportion to the degree of glycosuria. Gangrene and infection are recognized as grave complications for the diabetic. Since the complications of diabetes have been reduced perceptibly with the advent of insulin, blood chemistry and rational diet, the occurrence of such an unusual complication of diabetes as gangrene of the breast, seems worthy of reporting.

W U Disp, B2456, Jewish, female, forty-eight years of age, was admitted to the Jewish Hospital from the Washington University Dispensary. Three weeks before admission to the hospital she had noticed a small bleb in the lower medial quadrant of the left breast. The bleb increased in size and ruptured, discharging a serous fluid. She was seen by a surgeon, who applied an ointment. The bleb was replaced by a rapidly increasing area of necrosis. A very foul odor came from the breast. There was no incapacity. She did not give a history suggestive of diabetes, except for a loss of weight.



FIG 1—Showing gangrenous area of the breast

Physical examination showed an obese female who appeared ill. Head negative. There were harsh breath sounds and fine râles over the left apex. A soft systolic murmur was audible over the apex of the heart. Abdomen and extremities negative, except for palpable dorsalis pedis arteries. Examination of the left breast revealed it to be swollen with an infected gangrenous area over the left lower half of the breast about 6 cm in diameter (Fig 1). The necrotic area was surrounded by redness and induration. It was very tender to palpation. Temperature 103 degrees. Pulse 100. Respiration 24. Leucocyte count 22,000. Urine cloudy, specific gravity 1.022, acid in reaction, trace of albumen and Fehling's solution gave a markedly positive reaction for sugar. Acetone present. Blood sugar 0.213 per cent.

The treatment of the diabetes was carried out by Doctors Strauss and

Taussig Test diets were given along with 5 c c of insulin t i d Acetone disappeared from the urine in three days and she became sugar free in five days A maintenance diet was continued with 15 units of insulin daily

The surgical care of the breast consisted in applying hot boric packs until the slough separated and granulations appeared The granulating area became covered with epithelium and the patient was discharged from the hospital 36 days after entering

Approximately five weeks later after a dietary indiscretion, another bleb appeared on the left breast Her urine contained considerable sugar and acetone She was returned to the hospital for further treatment She again became sugar free and the breast has nearly healed

The effective treatment of diabetes by diet and more recently by the addition of insulin, is recognized as the first means of treating all complications The clinical progress of so-called diabetic gangrene is greatly dependent on the ability of the patient to maintain a proper diet and withstand infections In general, minimum operative intervention is indicated in diabetic patients, yet it must be radical enough in gangrene and infection to rid the patient of a focus likely to promote a glycosuria

JACOB G PROBSTEN, M D ,
St Louis, Mo

PROLONGED WEARING OF A PLASTER BANDAGE WITHOUT REMOVAL

EDITOR ANNALS OF SURGERY
SIR

July 16, 1918, a man, aged forty-seven, by occupation a farmer, presented himself at my office with a swollen, tender, right ankle which he stated was of six weeks' duration and due to an injury he had received when a large wooden gate had closed against him as he was passing through, and caught him above the heel while his foot was elevated on the toes in the act of making the step X-ray showed no fractures, but a softening of the astragalus, middle and internal cuneiform bones The foot was placed in a plaster bandage from the toes to the knee An inexperienced bookkeeper in the office, together with my entrance into the Army a few days later, caused me to lose track of the patient altogether This gentleman not thinking it necessary to write me, wore the bandage until December 6, 1922, when he again presented himself to the office for examination still wearing the original bandage Examination showed the foot to be sound When the case was removed, aside from a dry layer of cuticle about one-eighth inch thick covering the parts that had been enclosed in the case, and a complete deterioration of all cotton and bandage used beneath the case, no harm had been done The bandage had remained on four years and five months, which I believe has been the longest time such a case has ever been worn without removal

A DAVID WILLMOTH M D
Louisville, Ky

CORRESPONDENCE

PNEUMATIC INJECTORS IN LOCAL ANÆSTHESIA

EDITOR ANNALS OF SURGERY

Sir

Referring to an article by Dr William R Meeker in the January number of ANNALS OF SURGERY, entitled Instrumentarium for Local Anæsthesia, Doctor Meeker's frank condemnation of pneumatic injectors and his statement that "such do not simplify the employment of local anæsthetics," is decidedly at variance with my experience with a pneumatic injector designed by Dr R E Farr that I have been using for nearly two years

In my hands the abdominal wall may be much more easily and more completely anæsthetized with the Farr apparatus than by the use of any of the hand-operated syringes. Inside of the abdomen, the advantages of the Farr injector in delicately flooding various subperitoneal areas are outstanding and infinitely superior. As a general surgeon who applies the various degrees of local anæsthesia to conform to each particular procedure, it is my experience that there is no comparison between the two methods, the pneumatic injector being so much superior to the hand-operated syringe

ARTHUR ROGERS GRANT, M D,

Utica, N Y

THE PNEUMATIC INJECTOR FOR LOCAL ANÆSTHESIA

EDITOR ANNALS OF SURGERY

Sir

In the January, 1924, number of the ANNALS OF SURGERY there appeared an article by Dr William R Meeker, of Rochester, Minnesota, entitled "Instrumentarium for Local Anæsthesia"

As the instrument I have devised is the only Pneumatic Injector for Local Anæsthesia which has ever been placed upon the market and used to any great extent, the portion of Doctor Meeker's article pertaining to this instrument quite obviously refers to the apparatus devised by me. Doctor Meeker's criticism of the underlying principles, upon which the use of an apparatus of this type is founded, contains, I believe, a number of statements which, if allowed to go undisputed, may act as a harmful influence upon this most excellent method of obtaining anæsthesia

First As to the statement " * * * the only method of controlling the flow of the solution being by means of a stopcock " This statement totally ignores the most important refinement of the Pneumatic Injector, that is, the valve or cut-off which fits perfectly in the grip of the surgeon's hand and which allows him to inject into deep cavities without the hand intervening between the operator's eye and the point of injection. It furthermore ignores the operator's control of the solution which he has at his command at all times

Second As to whether " Such an instrument must of necessity be complicated, cumbersome and difficult to sterilize," even a superficial examination will show that the only portion of the apparatus with which the surgeon has

to deal is the valve or cut-off and needle. During fifteen years, cultures have been taken from the novocain solution, coming from the various models of the apparatus and have invariably failed to show bacterial growth. The fact that the cylinders and tubing can be sterilized by autoclave or by boiling, an attribute which is not common to all syringes, should effectively controvert the statement that the instrument is not easily sterilized.

Third. He states, "They usually require considerable work to assemble, which means that in most cases the adrenalin cannot be added to the novocain solution just before injection." Inasmuch as the assembling of the apparatus is entirely in the hands of the nurse, this statement should not constitute a serious indictment. The statement that the adrenalin solution cannot be added to the novocain just before using is an error for the novocain and adrenalin are *always* blended before being introduced into the cylinder.

Fourth. Doctor Meeker makes the point that "The fact that the operator does not furnish the force for the injection and that the pressure in the cylinder is the same in dense as in loose tissues, leads to an unequal distribution of solution." This statement assumes that one should ignore the most vital point in relation to the induction of local anæsthesia and that is the visualization of the point of the needle resulting from one's knowledge of anatomy and one's experience in developing the "feel" of the needle point as it meets varying degrees of resistance. His statement also ignores the fact that after only limited use of the Pneumatic Injector the surgeon develops a most acute sense of touch in relation to the tissues encountered by the needle point, and that he is furthermore in absolute control of the situation as the amount of pressure behind the solution can be changed instantly to meet the indications.

As to the question of muscle-tire, the facts are that local anæsthesia has failed to replace general anæsthesia with the degree of rapidity which its superiority justifies largely because its use has constituted in the surgeon's mind, an extra amount of labor and time, necessitating the mastering of numerous technical details. Another factor has been the patient's objection to the use of the method because of pain which has been produced by the faulty induction of local anæsthesia. It was, in fact, these considerations which impelled the writer to develop the Pneumatic Injector. Our many years of experience have demonstrated that it may be used for injecting all of the nerves of the body except in blocking at their origin the main trunks of the trigeminus, the brachial plexus and the sacral nerves.

The Pneumatic Injector, like syringes, is a mechanical device and therefore subject to imperfections. Yet an extended experience with this instrument leads the writer to unhesitatingly state that it offers the surgeon the best opportunity to introduce local anæsthesia solutions quickly, smoothly, equitably, accurately and painlessly of any instrument yet devised for this purpose.

ROBERT E. FARR, M.D.,

Minneapolis, Minn.

CORRESPONDENCE

THE USE OF THE CAUTERY IN THE TREATMENT OF ABSCESS OF THE LUNG

EDITOR ANNALS OF SURGERY

Sir

During the past few years, the literature has been replete with articles on abscess of the lung, pulmonary suppuration, etc. Lilienthal, Willy Meyer, Everts Graham, Robinson and others have contributed greatly to our knowledge in this matter. Within the last year, Graham casting about for a method less deadly than lobectomy, hit upon the use of actual cautery to ablate the cavity in lung abscess. He reports three successful cases. The method commends itself by its simplicity, and so far, by its affectiveness. Lobectomy is attended by a fearful mortality, probably over 50 per cent, in the hands of good surgeons. A method which promises as good a chance for cure, with no mortality, must be considered a boon to patient and surgeon.

The case, which is here

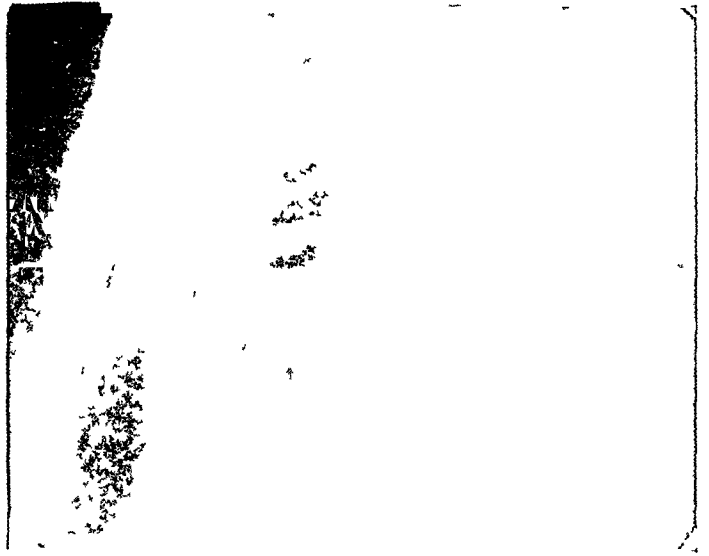


FIG. 1 —Before operation November, 1922



FIG. 2 —After first operation June 1923

reported, is particularly convincing as to the efficacy of cauterization, in that the abscess had been previously opened and drained without effecting a cure. As soon as the drain was removed, all the distressing symptoms cough, fever, and foul expectoration in large quantity recurred. Eight months after the first operation, a perfect cure was obtained by the cautery.

The patient was an Italian girl, age six, who had evening temperature for about two months in 1920. This subsided completely under rest in bed for six weeks. Her tonsils, which were badly diseased, were thought to be the cause of the slight fever. In December, 1921, she was subjected to tonsillectomy. About twelve days later, she was taken with sharp pain low down in the left chest, followed by fever, with slight expectoration. The fever persisted, ranging from 99° F to 100° F in the evening, and there was noticeable odor to the breath. Repeated sputum examinations were negative for

CORRESPONDENCE

tuberculosis. Later there was a gradual increasing output of foul, stinking sputum. At the end of two months this amounted to about three ounces daily. During this period the leucocyte count averaged about 13,000, but was once as high as 24,000. In October, 1922 the left lung was aspirated with a large needle under ether. No pus was found.

In November, 1922, eleven months after onset, she was seen by Dr. H. P. Shugerman, who made a diagnosis of lung abscess and insisted on operation. X-ray showed a vague shadow covering the entire lower left lobe. At this time the patient was referred to me for operation.

I did a wide thoracotomy opening along the upper border of the eighth rib. The rib was not severed but wide retraction gave a splendid view. Between the diaphragm and the lower lobe was a grayish spot about 1×2 cm. A needle introduced here obtained 5 cc of thick yellow pus. The examining finger, plunged into the abscess cavity, found pus and necrotic lung tissue with a dense hard surrounding wall. The cavity connected mesially with a large



FIG 3—January 24, 1924. Shows left diaphragm and lower chest clear.

bronchus. A rubber tube about one-half inch in diameter was inserted as a drain, a small section of rib being removed for this purpose, the wound closed by interrupted chromic gut embracing the two ribs which had been separated by the incision. Skin closed with interrupted sutures of silkworm gut and the drainage tube fastened to the skin by the same means.

Recovery was prompt. For a day or two there was blood-tinged, frothy expectoration, then none. At the same time there was a profuse foul-smelling purulent discharge through and about the drainage tube, which after a few days, had to be removed and cleaned every day. The drainage was maintained for two months. Patient gained rapidly and was free from fever and cough, and there was no expectoration. As soon as the tube was removed and the wound closed, all the



FIG 4—Patient recovered, wound healed.

CORRESPONDENCE

old symptoms returned at once. After two weeks the drain was re-inserted under novocain. Prompt relief.

After two weeks of comfort, the drain slipped out and could not be replaced. Immediate recurrence of all distressing symptoms. She continued in this condition with fever, loss of flesh, strength and appetite. The amount of sputum gradually increased until the daily output was more than a pint. In the latter part of June, 1923, the patient had three alarming hemorrhages within ten days. She coughed up a pint of red fluid at one time, which contained enough blood for the entire mass to clot.

It was decided to try to ablate the abscess cavity with the actual cautery. Accordingly, July 7, 1923, the patient was etherized and an incision was made along the upper border of the seventh rib. A segment of which one-half inch in length was resected near the angle. A similar segment was taken from the sixth rib. This gave an excellent exposure, and removing the segment prevented the after distress which is occasioned by the sawing, grating sensation in cases where the ribs are merely severed. The lower lobe was very small, almost totally collapsed and felt firm. It looked like a carneous lung. An exploring finger was forced through adhesions into the old

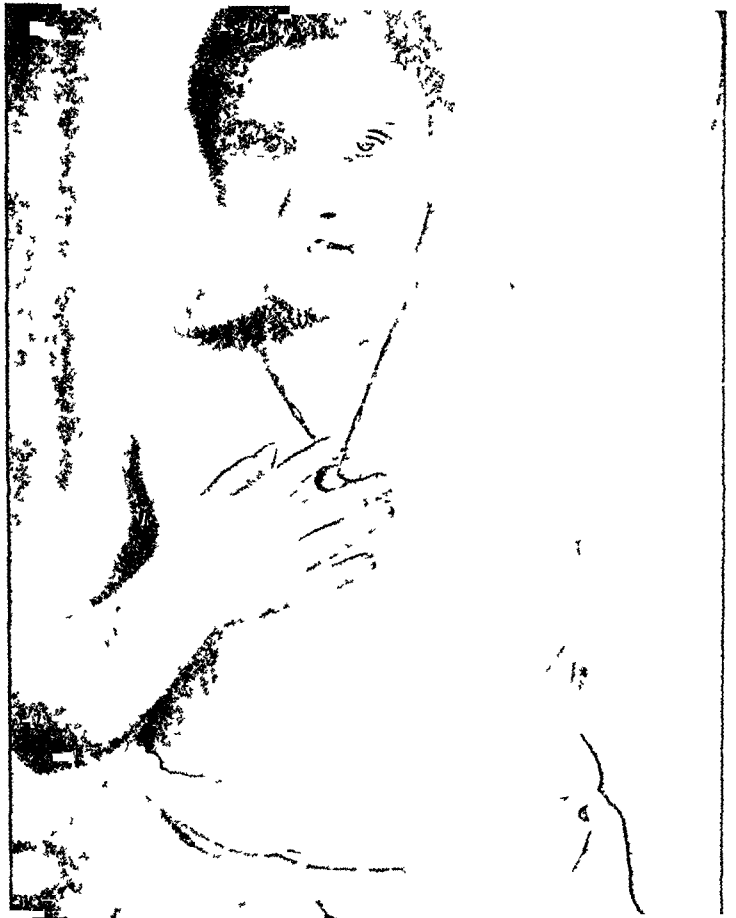


FIG. 5 —Patient recovered, wound healed.

abscess cavity. Blood clots, several bits of necrotic lung tissue the size of one's finger-end were removed. The cavity readily admitted three fingers and was slightly larger than a hen's egg. Air rushed in and out with the respiratory excursions. The ether having been removed to a safe distance, with the cautery tip in the cavity, and the fingers of the left hand on the surface of the lung in such manner that the two could be approximated, thereby gauging the pressure exerted by the cautery tip, the hard shell-like wall of the cavity was methodically burned away until everywhere the fingers felt soft lung tissue. During the application of the cautery, smoke issued from the nose and mouth. The ordinary flat electrode was used. After applying the cautery fifteen or twenty seconds, complete apnoea would result. Movements of artificial respiration would again induce breathing. This was repeated about five times. The manner of applying the cautery was by short interrupted strokes, much as one would spread a stiff ointment with a spatula. A stiff brush was most useful in cleansing the cautery tip. The cautery tip was plunged into the large connecting bronchus, after an unsuccessful attempt to close its lumen by suture. A large rubber tube was inserted deeply into the cavity, and rubber dam packed loosely about, in such manner that it could be removed alongside the drainage tube. Hemorrhage, which might conceivably happen after cauterization, did not occur. Convalescence was uneventful. For three days respiration was increased and the temperature rose to 102° F, then gradually fell to normal. There was some cough, but no expectoration.

CORRESPONDENCE

Drainage from the wound was fairly profuse at first, but rapidly diminished, and in ten days was very slight. Three weeks after the operation, the tube which had been gradually shortened, was removed, and three days later the wound had healed. The patient, whose temperature had now been normal ten days, was allowed to go home. She gained rapidly in strength and flesh, and her appetite was enormous. She has had no fever, no cough, and no expectoration since leaving the hospital. The wound has remained perfectly healed, and is free from pain and tenderness, and there have been no hemorrhages. In seven months she has gained fifty pounds, the clubbing of the fingers, which was extreme, has almost entirely disappeared. In every way she is to-day a normal healthy child.

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Remittances for Subscriptions and Advertising and all business communications should be addressed to the

ANNALS of SURGERY

**227-231 S. 6th Street
Philadelphia, Penna.**

ANNALS *of* SURGERY

VOL. LXXIX

MAY, 1924

No. 5

THE CONTINUED INTRAVENOUS "DRIP"

WITH REMARKS ON THE VALUE OF CONTINUED GASTRIC DRAINAGE
AND IRRIGATION BY NASAL INTUBATION WITH A
GASTRODUDENAL TUBE (JUTTE) IN
SURGICAL PRACTICE

CORRECTION HERBST

In Doctor Herbst's article entitled "Malignant Tumors of the Thyroid," which appeared on p 488 in the April issue of ANNALS OF SURGERY, a line has been omitted from the first paragraph. The words omitted are "twenty-four with malignant papilloma who were operated on, and eighty-three", these words should constitute the fourth line of the paragraph, being inserted after "and" at the end of the third line

as a secondary measure to follow, the primary massive intravenous infusion of sera (saline or glucose solution) which, in profoundly shocked, exhausted and starved surgical patients, are more often temporary or ephemeral in their effects

In many shocked patients, as we all know, the immediate restorative effect of a hot intravenous salt or glucose infusion is, for the time being, brilliant; but this effect is more often transitory, so much so that it suggests that the fluid injected has simply run out of the vessels into the tissues, just as if that much water had been poured into a sieve. Hence the efforts that have been made to hold the infused fluids in the circulation which we recognize in the introduction of the gum-salt solution of Bayliss, the gelatin of Hogan, etc., which tend to imitate plasma, rather than the serum of the blood, by increasing the viscosity of the injected fluid

But even then dilution soon follows, and these solutions, which cannot be injected indefinitely, soon seep out of the vessels or accumulate in the

* Read before the American Surgical Association June 2, 1923

reservoirs of the great splanchnic veins, leaving the arterial system empty, the peripheral capillary circuit stagnant and the patient as collapsed as before the infusion. The advantage of the constant drip lies in the steady stimulation with an isotonic oxygen and pabulum-carrying fluid which not only replaces the lost fluid for an indefinite time but stimulates and nourishes the heart muscles and brain centres continuously without overcrowding the heart. Thus the storing of energy in the cellular batteries is kept up and the metabolic processes continued, provided no permanent degenerating or necrogenic cellular changes in the vital territories of the master organs have already occurred, which would make them incapable of responding to any form of stimulation.

4 The value of the continuous intravenous drip is especially apparent in the post-operative treatment of septic abdominal cases in which dehydration and exhaustion caused by prolonged vomiting and fasting from mechanical obstruction or toxæmia, have preceded the operative act, and when the absorbent and eliminating functions, as well as the mobility of the gastro-intestinal tract, have been so paralyzed and inhibited that the usual avenues of supply by the oral, rectal, hypodermal or gastroduodenal route *via* the duodenal tube (Einhorn, Rehfuß, Jutte) or even the cholecyst-duodenal drip (McArthur, Matas) are blocked or unavailable.

5 Notable examples are Intestinal obstruction and septic peritonitis from multiple perforating gunshot wounds of the abdomen, ruptured appendix, perforating gastric and duodenal ulcers, obstructed common duct with hepatic insufficiency, gangrenous gall-bladder, advanced pyloric obstruction from carcinoma or benign stricture, with marasmus from prolonged starvation, or after nephrectomy from pyonephrosis with threatened anuria. In many of these, and especially the delayed cases, operations have to be performed in which the primary focus of infection or an obstructive lesion is removed, but the patient is left profoundly shocked, toxic and exhausted, with empty arteries, a stagnant capillary and venous circulation, and with dry, dehydrated tissues dying of thirst and starvation.

6 Every surgeon of experience knows that in the particularly grave cases that we have in mind the rectal drip (proctoclysis), even when retained, is of little or no service, it is frequently not absorbed, especially when the portal circulation is stagnant, as in advanced peritonitis with marked tympanites, and it is frequently not retained or even tolerated, and therefore fails when it is most needed. Hypodermoclysis, which is most useful as a preliminary measure or during the operation, also fails when the capillary circulation is at a standstill or failing from shock after the operation. Subcutaneous absorption is then either so long delayed or suspended from capillary stasis that very little of the fluid is absorbed and remains in great œdematous collections under the skin. The same may be said of the gastric or duodenal drip administered through a small duodenal tube (Jutte) introduced through the nose into the stomach and allowed to remain *in situ*. When the intestinal tract is paralyzed and peristalsis is arrested or reversed (regurgitation of intestinal contents) the fluids introduced through the tube accumulate in the stomach and are not absorbed. When septic peritonitis, acute gastric dilatation or adynamic intes-

THE CONTINUED INTRAVENOUS DRIP

tinal paralysis complicate an operation for chronic obstructive jaundice or from other causes the fluids introduced into the duodenum *via* the gall-bladder ("McArthur drip") or through a catheter introduced into the common duct ("Matas drip") are regurgitated into the stomach and not absorbed even after all obstructions to the common duct have been removed.

7. In the presence of a collapsed, practically pulseless patient, when it is evident that none of the above-mentioned indirect methods of restoration is efficient or available, the first and prime indication is met by the prompt intravenous infusion of a stimulating isotonic fluid capable of replacing the lost or displaced blood.

8. The transfusion of citrated or, preferably, whole blood is undoubtedly the most efficient restorative, but this is not always available in emergencies, nor is its immediate beneficial effect always sustained, nor can it be applied continuously for an indefinite time when, for any reason, the main avenues of fluid supply are blocked or inhibited, as in septic peritoneal intestinal stasis; nor is it necessary or essential that blood should be used in many cases when other provisional means of supplying the circulation with fluids are available. Suffice it to state that for the majority of the emergencies under consideration an artificial serum infused intravenously will meet the immediate indications by spurring the cardiovascular mechanism to renewed activity. This rally may be permanent and sufficient or it may be transitory. In either case the cannula is to remain in the vein until the issue is determined by the further course of events.

9. If after a primary massive intravenous infusion the patient relapses again into the collapsed state or it is evident that the circulation is failing, the infusion is renewed in the form of a continuous drip, by which the artificial serum is administered with precision and exact dosage at a rate varying, according to indications, from 40 to 60 drops per minute, or, roughly, an average of 6 ounces per hour, or 140 to 150 ounces in the twenty-four hours (4500 to 5000 c.c.). In this way quantities varying from 4 to 5 litres of fluid or more, are infused directly, gradually and surely into the circulation in the twenty-four hours.

10. With increasing experience we have learned to rely prophylactically upon the intravenous drip in the very feeble, ill-nourished patients whose ability to survive an operation is doubtful. In these cases the intravenous drip is started with the operation and is continued *guttatim*, during and after the operation, as long as doubt exists as to the efficiency of the circulation. In these exceptional circumstances the intravenous drip is substituted with advantage for hypodermoclysis—the so-called "axillary sup," or for the rectal drip (proctoclysis)—since in the particularly feeble class of patients previously referred to, absorption is uncertain or likely to be long delayed.

11. The *duodenal tube as an adjunct to the continuous intravenous drip* is simply of priceless value. In the form of the Jutte tube, with its small bead-like tip ("sinker") and numerous perforations at its rubber terminal end, it is easily introduced through the nose into the stomach with little difficulty. Once in the stomach, it is allowed to remain permanently *in situ*.

and held to the nose externally by strips of adhesive plaster. There it is kept in place as long as the gastric contents are retained or intestinal peristalsis is reversed with regurgitation of the duodenal or jejunal secretions into the stomach. This is usually the case in all obstructive or paralytic states of the bowels caused by septic peritonitis and other causes. Under these circumstances the necessary nutrient and artificial sera are regularly supplied by the intravenous drip while the duodenal tube is also at work emptying the stomach of the foul and constantly accumulating intestinal contents. The Jutte tube, as usually supplied by manufacturers, is long enough to hang over the side of the bed below the level of the patient to permit of constant drainage of the gastric fluids by syphonage, prompted by an ordinary glass "Triumph" syringe. The tube in this way acts as a drain for the fluids and allows of the continuous escape of gases which would otherwise accumulate in quantities in the stomach. When the stomach is empty the tube is hung up above the head of the patient and held attached to a post of the bed by adhesive plaster, leaving it open to allow the gases of the stomach to escape uninterruptedly as they accumulate.

By draining the stomach the gastric tube acts in reality as an artificial anus which empties the upper intestine of its toxic contents and diminishes the abdominal tension caused by the pent-up gases, thereby adding enormously to the comfort of the patient.

The Jutte tube passed through the nose does not interfere in the least with the voluntary, free and copious drinking by mouth of water or other pleasant, cool, refreshing drinks. The patient is thereby relieved not only of vomiting but of the intense thirst which is so distressing and peculiar to these patients. By using the tube as a syphon through the nose while the patient is drinking, the ingested fluids are immediately returned and the stomach is kept clean and the disgusting foulness of the intestinal contents is eliminated.¹

12 *Gastric irrigation through a permanently attached Jutte tube as a refrigerant and antithermic agent.* When the fever is high the temperature may be lowered most effectively by allowing the patient to drink copiously of ice water by mouth, or the stomach may be alternately filled and emptied through the tube with ice water many times and for as long as may be required to obtain a reduction in the rectal temperature. The stomach then serves the purpose of an ice-bag, most conveniently placed under the heart, the liver and over the aorta and vena cava, where the blood circulating in the heart and the greatest central splanchnic area of the body can be cooled directly as it is sped by the heart to the most distant peripheral regions of the body. The stomach when cooled by a continuous or intermittent ice-water irrigation serves far more effectively as an antithermic agent than any ice-bag, sponging, towelings or other cooling methods applied externally. It is superior, under these circumstances, to the cold Kemp rectal irrigation and has the added advantage of keeping the stomach clean while the patient is refreshed and comfortable. On the other hand, when the patient is shocked, algid and hypothermic, warm or hot water can be infused into the stomach by gravity and siphoned off with no disturbance to the patient, who may be entirely

unconscious of the procedure, but who is stimulated and warmed by the heat applied directly to the heart and splanchnic organs in a way that is far more effective than any external application. Of course, this central stimulation by heat in no way conflicts with the artificial warming of the exposed peripheral parts with hot-water bottles, bags, blankets, electric pads, etc., as is usual in reanimating shocked and algid patients.

13 But apart from its many uses as a gastric drain, irrigator and flue (for gases), the Jutte tube, introduced through the nose and allowed to remain permanently in the stomach, is also valuable in other surgical conditions of impoverished nutrition and exhaustion in which the early instillation of nutrient fluids directly into the intestine is indicated. A notable example of such an indication is afforded by advanced cases of pyloric obstruction from benign or malignant stricture, for which a late gastrojejunostomy is performed in conditions of long fasting or marasmus. In such cases it has been our practice, while performing a gastro-enterostomy, to introduce a duodenal tube, previously inserted through the nose, into the jejunum for a distance of 10 to 12 cm. through the newly created stoma, where it is allowed to remain after the gastro-enterostomy has been completed and until the normal gastric functions have been resumed. The tube thus introduced into the jejunum is utilized immediately or shortly after the operation as a transgastric jejunal drip, which supplies a peptonized glucose solution in a far more certain way than when this is administered by the usual rectal drip (proctoclysis).

The manifold uses of the Jutte tube in the surgery of the gastro-intestinal canal are becoming more apparent every day as one of the most precious adjuncts to the post-operative treatment for the especially dangerous class of patients with whom we are now concerned. The growing appreciation of the value of the tube, though referred to in several recently published contributions by gastro-enterologists, is not sufficiently recognized in surgery and deserves a more extended notice †. I have only incidentally referred to the uses of the tube in this communication because of its great importance as an auxiliary measure in the very cases in which the intravenous drip is indicated and in which we have found it most frequently applicable.

14 *The Technique of the Intravenous Drip* As applied in our practice at the Tourcoing Infirmary, the apparatus is of the simplest sort. It is precisely the same as that used for massive intravenous infusion with only a few modifications: (1) A glass graduate container of a capacity of 1 litre or more of solution, (2) a delivery rubber tube which is interrupted by interposing a tapped glass bulb (Murphy "drip bulb") which allows the nurse to observe the rate of flow and count the drops as they are delivered from the receptacle,

† The value of the duodenal tube in abdominal surgery as a post-operative resource is also emphasized by the following quotation from Bassler (Southern Med Jour, 1919, vii, 4): "If I leave no message with you, but the use of transduodenal lavage in post-operative ileus, I feel that my paper has not been in vain. Its employment is of distinct advantage and will bring happiness to you."

(3) a thumb-screw clamp which controls the rate of flow, (4) a metallic cannula provided with a beaded or shouldered tip to prevent the cannula from slipping out of the vein after it has been tied in place, (5) a Duchesne's electric pad. This is a mechanical device by which intravenous infusion hypodermoclysis and proctoclysis can be administered at a uniform temperature. The pad with its tail is light, pliable, perfectly safe, easily adjusted and always ready for immediate use, as it can be attached to an electric-light socket. It

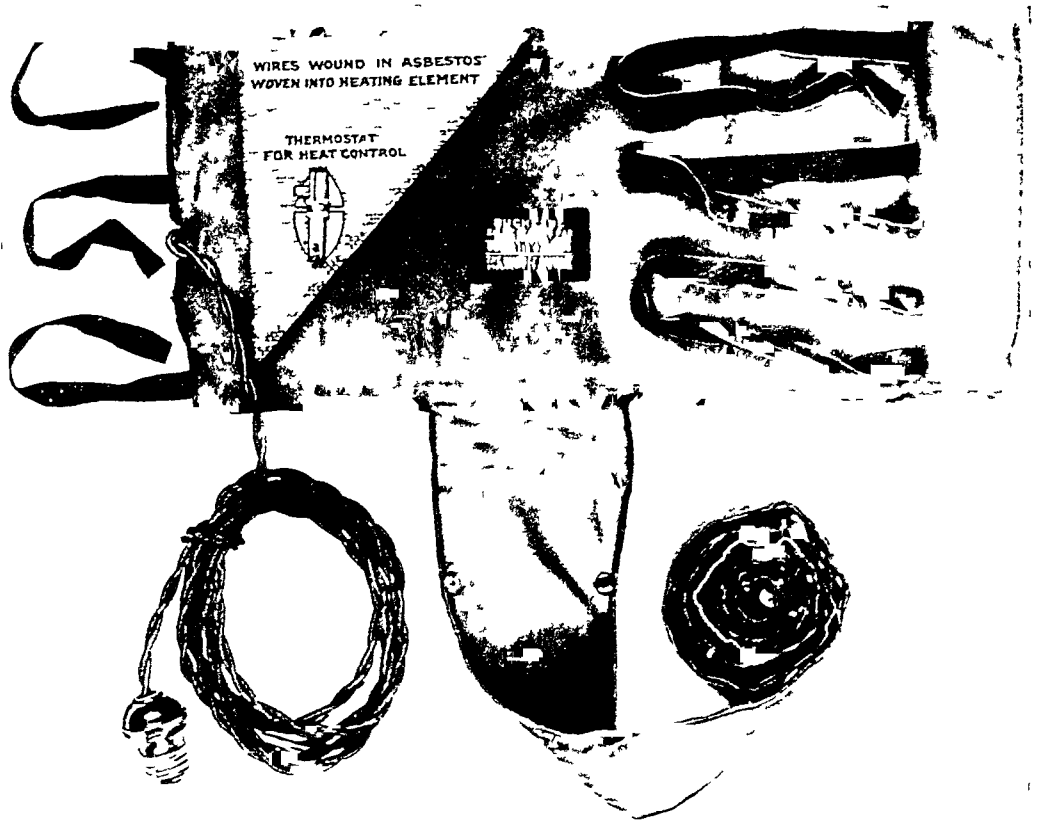


FIG. 1.—The Duchesne electric heating pad

heats quickly, maintains a definite degree of heat as long as desired and the cost is reasonable. "The heating element inside the pad and tail consists of wire interspersed with strands of woven hemp. This wire is of special alloy and threadlike fineness, but is very strong. It is thoroughly insulated with asbestos. A platinum contact thermostat is attached so that a definite degree of heat is controlled automatically at all times when in use. The pad is 9 inches wide by 21 inches long and can be adjusted to various receptacles of various sizes and shapes by tapes attached to either end of the pad. The tail is 54 inches long, 4 inches wide, provided with snaps so arranged as to completely wrap the tubing, and the end at the cannula may be secured to the dressings which hold the arm to an extension splint or board with a safety-pin through the eyelet provided for that purpose. The outer covering of the pad and tail are of waterproof material. The device is so arranged that

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the heat produced in the pad will deliver the solution originally heated to 110° F, at a temperature of 100° to 102° F, when it reaches the cannula." We have found this device a most excellent substitute for the old method of keeping the solution in the receptacle and tubing warm by the use of thermos bottles and hot-water bags, which were formerly used at great cost of labor and vigilant attention and yet without obtaining the desired uniform temperature at the cannula. A description of this ingenious and carefully worked-out appliance will be found in the American Journal of Nursing for March, 1923, p 470, in an illustrated article, by Mary L. Duchesne, R N.

A number of devices, more or less ingenious, simple or complicated, for the administration of artificial sera and medicated solutions by the drop method, have been utilized for proctoclysis, hypodermoclysis and endophleboclysis (intravenous infusion). Some of these aim solely at accuracy of dose, others at uniform temperature, and nearly all at both desiderata. Among these can be mentioned the apparatus of Holzbach, Friedemann, Ruebsamen and Lawen in Germany, of Thierloix in France, of Woodyatt, Thalsheimer, Penfield-Teplitzky and Pena in America. With these we have no experience. They are no doubt valuable and meet certain special indications, but for our purpose the simple apparatus above described with the ready and practical warming device of Duchesne, has satisfied all our clinical requirements.‡

15 In connection with the continuous intravenous drip the following points should be remembered. The cannula should have a lateral as well as a terminal opening, it should be made fast to the vein in the usual way by ligating it well over the bulbous tip, the median basilic or other prominent vein is preferred as an ordinary temporary intravenous infusion. A glass-connecting tube should be interposed between the rubber segments of the delivery tube at a distance of 6 inches (15 cms) from the cannula, so that any backflow of blood or blood-stained solution should advise the operator of an obstruction at the cannula, the cannula should be immobilized and held in place by Z O adhesive strips, and, in addition, the terminal end of the delivery tube should

‡ At the time when this paper was read at the meeting of the American Surgical Association in June (1923), the writer had no knowledge of the contribution of Penfield and Teplitzky, on "Prolonged Intravenous Infusion and the Clinical Determination of Venous Pressure," which appeared in the Archives of Surgery for July (vol vii, p 1, 1923). The very thoughtful, thorough, scientific way in which these investigators have worked out the problems of the continued administration of intravenous infusions is most creditable and praiseworthy. Apart from the ingenious apparatus devised by these investigators which regulates the rate of flow and the degree of heat of the solution, the manometric indicator of the venous pressure which is attached to the delivery tube, gives the Penfield-Teplitzky apparatus the scientific quality of a physiological laboratory apparatus which is of undoubted value for accurate clinical observation. Great stress, and very properly, is laid by the authors upon the importance of recording the variations in the venous pressure while the infusion is in progress and the easy reading of the pressure by the manometric indicator provided with the apparatus, constitutes a decided advance in the technic of the method. However, it is evident that in all these years, surgeons everywhere resort and have resorted successfully to intravenous infusions and

be bandaged to the arm to prevent the slipping and traumatizing movements of the cannula, which would provoke the clotting of blood in the vein. For the same reason it is important that the cannula should be kept parallel with the vein and not point into its lumen at an angle. The whole arm, including the hand, should be bandaged firmly to a long, well-padded extension-board splint, and again secured to the bed or to a side table, to prevent motion of the arm in restless patients during the long period of continued instillation. In introducing the cannula the usual care should be observed to see that the solution is actually flowing from the cannula at the moment it is inserted into the vein, to avoid the sudden entrance of air. For the same reason watchful care should be observed to see that the receptacle is kept constantly supplied with the sterilized solution and that the proper drop rate is maintained. The drop count will vary with circumstances, no fixed or rigid rule can be prescribed for any great period of time. The rate of flow must be regulated by the indications furnished by the pulse.

The average rate should be about 40 to 60 drops per minute, slowed to 40, 30 or less, with an improving pulse and a rising blood-pressure. It may be increased temporarily to 150 or to a continuous flow when there is greater need of stimulation, as shown by an empty, small and thready pulse.

transfusions without the aid of a manometric indicator of the venous pressure. It is precisely because our observations with the long-continued intravenous drip administered by the simple and elementary technic above described, confirm the universal experience and prove that a manometric gauge of the venous blood-pressure is not indispensable or necessary for the safe administration of venous infusions, that our experience is instructive. It is more than probable that if in the beginning of our practice we had been preoccupied with the necessity of an accurate reading of the venous pressure we would have been completely deterred from attempting it. In the same way we have learned by practical experience that the fear of air embolism and thrombosis have been exaggerated, and, later still, we have found that accurate methods of regulating the heat of the infusions are not as essential as we thought them to be. All this does not mean that we should be indifferent to any suggestions, measures or devices that contribute to the accuracy of our procedures or that reinforce our clinical sense by providing visible danger signals or that guard against preventable dangers and complications. Whatever will contribute to the safety of the patient is a welcome addition to our resources, and it is in this sense that the venous pressure gauge of Penfield-Teplitzky is a valuable suggestion in line with scientific progress, which it is hoped will find a more general application in hospital practice. On the other hand, in the surgical emergencies in which intravenous infusion is imperatively called for as a prompt means of relief, the simplest and most quickly improvised apparatus should be utilized. In a general way, the experienced clinician needs no sphygmomanometer or stethoscope to tell him when a patient is in danger from shock and exhaustion, or when the pulse is failing, the heart weakening, the arteries emptying, the veins filling and the capillaries stagnating. But experience is not a measurable quality and the fallacies that underlie individual judgment are so well recognized that the efforts made in every direction to control or supplement the evidence furnished by our unaided senses, by graphic mechanical methods of objective demonstration, constitute one of the most striking advances of modern medicine. Therefore, we must regard as real progress any suggestion or method which, as in this instance, aims at combining with the requirements of practice the precision and automatic registration of varying functional conditions which are the part of laboratory experimentation.

THE CONTINUED INTRAVENOUS DRIP

16 *Temperature of the Solution* In regard to the temperature of the solution this also must vary with conditions. When the temperature of the patient is high the solution should be of an ordinary room temperature and the use of the heating device should be discontinued. When the temperature is falling or hypothermic, as shown by the rectal thermometer, the solution should be warm, at least 100° to 104° F at the cannula when in addition to its warming effect, a specially stimulating action upon the myocardium may be expected.

The cause of the frequent occurrence of a reactionary chill and fever, usually while the infusion is in progress, and often within the first hour after the infusion has begun, has been the subject of much discussion. The chill is usually quite pronounced and is announced with marked shivering and shaking. While the extremities are cold to the touch, the rectal temperature rises rapidly until it reaches 103.5 and 104° F or more. It attains its maximum height in the first two hours and then gradually defervesces and subsides to normal within the next six or twelve hours. It is more likely to occur when shock is associated with hemorrhage or sepsis. During the chill or cold stage the arterial blood-pressure falls, the pulse becomes rapid and irregular and the signs of venous and capillary stasis are apparent. As the chill passes and the surface temperature rises, the blood-pressure rises, the pulse becomes slower, fuller, rapid, but regular, the lividity and cyanosis disappear, the facies flushes and the extremities warm again. After defervescence the skin becomes drenched by perspiration. This chill and fever which is regarded as a reactionary phenomenon is monoparoxysmal and self-limited. In hemorrhagic patients who have rallied from the effects of the infusion, the defervescence of the fever coincides with the recovery of the patient, *i.e.*, if the source of the hemorrhage has been controlled. As a whole this complication is to be regarded as an epiphenomenon which, while disturbing and tempestuous, is not *per se* of grave prognostic significance. Though I am not able to state the matter statistically, it is my impression that more patients have recovered after it, than those who did not exhibit it. The nature and cause of this reaction is still a matter of conjecture. In our experience it has occurred irrespective of the composition of the solution, whether salt or sugar alike. It appears to me that it has occurred more often when massive infusions (over 2000 cc per hour) were used in the start, rather than when the drop method was resorted to. But as the large majority of our cases were first given massive infusions, we are not able to make an accurate estimate of the relative frequency of the chill and fever after the massive and the drop method. We are quite satisfied that the temperature of the solution is not a cause, neither do we believe that it lies in the presence of foreign material or impurities in the rubber used in the tube, since we have observed the "infusion reaction" has occurred in some patients and not in others, when using the same solution, at the same temperature and with the same apparatus. Variations in the hydrogen ion concentration in the solution used—too acid solutions—have been considered a possible cause of the reaction. While we are not able to express any judgment on the subject, we are inclined to doubt that the cause of this reaction can be explained on this basis. In our experience it may occur after citrated and even whole blood transfusions as well as after saline and glucose infusion, though it is more frequent after the simple massive infusions of artificial sera. Why a certain number of patients react in this way and others do not still remains conjectural. Thus far it would seem to be a matter of individual susceptibility, something residing in the patient himself, rather than in the material with which he is infused. But whatever the cause, the occurrence of this reaction does not aggravate the prognosis *per se* and other conditions being equal it should cause no undue alarm.

17 *An Embolism and Thrombosis* Again, in connection with the technic, it is well to state that the two great fears which have stood in the way of the more general application of the intravenous drip—air embolism and thrombosis, with the possibility of a detached clot—have no doubt been very much exaggerated. While it must be admitted that neither of these dangers is negligible and that accidents from these causes may occur, it may be stated, as a matter of fact, that they have never been observed in our experience nor in that of the many observers abroad (especially in Germany) who have recently published their observations. We have previously stated that precautions are taken against air embolism. These consist chiefly in inserting the cannula into the vein while the fluid is flowing from it, then to see that the receptacle containing the solution and the Murphy tap are not allowed to run dry. This is precisely what is done in all cases in which a massive intravenous infusion is given, and, thus far, no accidents have been recorded from this cause in the hundreds and thousands of cases in which the procedure is currently applied in the surgical practice of all hospitals. It is quite well proven by experimentation that it is only the sudden and forceful injection or aspiration of a large quantity of air into a vein that is at all likely to be followed by embolic manifestation.

In regard to thrombosis in the vein, or at least clotting in the cannula, it may be stated that it is not an infrequent occurrence. When this happens the fluid in the cannula ceases to flow automatically and the event is announced quickly by the accumulation of fluid in the counting-drop bulb in the same way that it occurs in proctoclysis. When it is evident that the obstacle is not caused by the mere obturation of the cannula by the venous wall, through displacement or angulation, the cannula should be removed and cleared of clot if this is plugging its lumen. If no clot can be detected in the vein by gently massaging it, the cannula (well oiled) is again reinserted in the same vein. If the wound is not inflamed the procedure can be repeated two or three times with safety. When the wound is inflamed, as shown by a marked areola of redness and œdema of the edges of the incision, as may happen when the drip is prolonged for days, it is best to seek another vein, preferably in the same or in the other arm. It is safer to use the veins of the upper extremity than those of the lower limbs, as the tendency to thrombosis in the legs and thighs is, relatively speaking, greater in the lower than in the upper extremity. The secret in avoiding thrombotic occlusion of the cannula or in the vein lies in the continuance of a steady drip from the cannula, as long as the solution drops at the low rate of 20 to 30 drops per minute there is little likelihood of clot formation, especially when the cannula is kept well fixed and immobilized in the arm. Our experience in this regard tallies exactly with that of Friedmann and others especially experienced in this method. One fact is certain, and that is, that in a very considerable experience in the long-continued intravenous drip (in 2 cases lasting five and six days), we have not had to deplore any accident from a detached embolus.

THE CONTINUED INTRAVENOUS DRIP

18 *The Solution* What solution is to be preferred when an intravenous drip may have to be continued not only for hours but for days? Shall it be plain salt or sugar (glucose) or a complex serum? This question has been made the subject of much discussion ever since Joenischen, of Moscow, first resorted, in 1830, to saline intravenous infusion for the treatment of cholera and other dehydrating diseases. Numerous formulæ of an isotonic or physiological artificial blood serum have been suggested by physiologists and internists long before the intravenous solutions were adopted for surgical conditions. This discussion has practically resolved itself, in modern surgical practice, to the general conclusion that for emergencies and temporary purposes the so-called normal, decinormal or physiological salt solution (NaCl, 0.7 or 0.9 per cent) is isotonic and suitable for all practical purposes as a replacing fluid. But for a long-continued instillation, glucose is the best material and should be preferred *ab initio* whenever possible. I arrived at this conclusion more than fifteen years ago following the suggestion of Friedrich, of Marburg, and Lennander, of Upsala, who resorted to glucose solution for hypodermoclysis in septic peritonitis in 1905. When I began the practice of the intravenous drip, in 1911, I first used salt, but soon after substituted a 5 per cent glucose for the plain

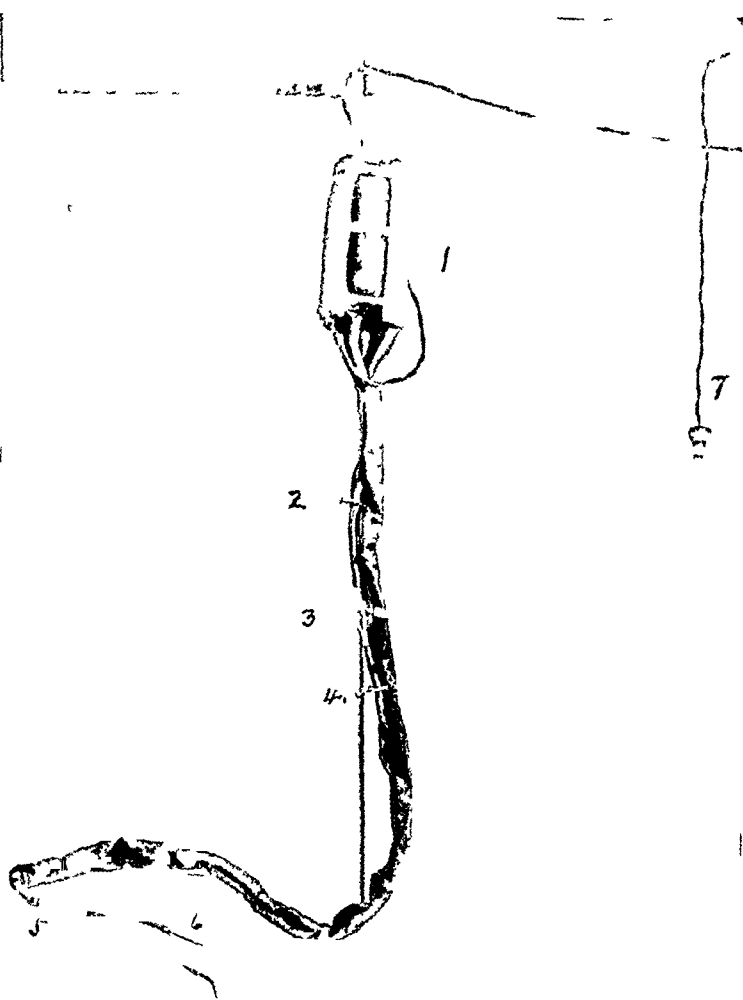


FIG 2 —The Author's adaptation of an ordinary infusion apparatus for the administration of the Continued Intravenous Drip. 1 Glass (Kelly) bottle containing glucose or saline solution showing the Duchesne Electric Heating Pad adjusted and folded back, leaving the graduated scale exposed. The tail of the pad is provided with snaps so arranged as to completely wrap the tubing except for a depth of about 30 cms from the cannula, which remains uncovered. 2 Screw compressor to regulate the flow of the solution in the tubing leading to the Murphy drip bulb. 3 Murphy drip bulb showing a hypodermic needle inserted in the vent when the solution is to be medicated with stimulating or cardio-tonic drugs (Adrenalin Pituitrin Digitalin Strychnine Caffein etc). The bulb is exposed to view so that the drop rate may be always under inspection. 4 Second screw compressor to control the flow in the bulb and maintain a constant visible level of the solution in the bulb, thereby excluding air from the drip. 5 Glass joint connecting the terminal tubing and cannula and exposed to view to detect any reflux of blood from the vein. 6 Cannula curved and bearded, or shouldered at the tip (to prevent it from slipping when tied to the vein) and provided with a terminal and side opening. 7 Plug and cable attached to the Duchesne pad ready to connect with an electric light socket.

salt solution Up to that time (1911) salt solution had been used exclusively in our practice (See bibliography)

Saline Solution While everyone agrees that a normal or decinormal so-called physiological salt solution is isotonic with the blood and is also sufficient, for life-saving purposes in hemorrhage, to replace the lost volume of blood, its continuous intravenous administration is not without serious drawbacks and dangers As Straub (1920) pointed out the so-called physiological salt solution is not physiological for warm-blooded animals "He quotes Roessle to show that organic changes occur in the human heart muscle after saline infusions In some animal experiments, Hoeszli produced tissue lesions in the heart and kidneys of guinea-pigs, lipoid droplets and fat globules appeared in the cells These degenerative changes can be detected six to seven hours after massive saline infusions They become most apparent in twenty-four hours and disappear in forty-eight hours Hoeszli believes that Na-ions play a decided part in the causation of these changes Thiess pointed out, in 1910, that a healthy man needs 17 gm of salt per day, but receives 27 gm when given 3 litres of a 0.9 per cent salt solution He maintains that part of the salt is eliminated by the kidneys, but some is retained in the tissues, where it attracts liquids and causes oedema" (Wiedhopf and Hilgenberg, 1923) This is especially true in patients whose sodium chloride elimination is interfered with in acute toxic or chronic nephritis and in bronchitis or chronic cardiopulmonary diseases in which oedema of the lungs is favored by salt retention The dangers of salt retention have been too long insisted upon by the French school (Widal and Javal, 1903) and are too well recognized to be insisted upon The effect of salt retention in disturbing the balance of osmosis and favoring dropsical accumulations are the basis of the now classical saltless diet of Widal, prescribed for the anasarca of nephritis and other dropsical diseases Consequently, salt infusions, whether by hypodermoclysis, intravenous drip or by any other method of administration are positively contra-indicated in all toxic states in which degenerative changes in the renal epithelium with salt retention occur, and also in all conditions in which pulmonary stasis from an enfeebled cardiovascular circulation predispose to hypostatic oedema of the lungs

Various formulæ have been recommended as substitutes for plain salt solution The tendency to return to the older complex formulæ for artificial serum in vogue in the latter part of the last century and even now in physiological laboratories (Hayem, Beaumetz, Jennings, Kronecker, Schmidt, Schwartz Ringer, Locke, etc) is shown in the recent recommendation of the normosal of Straub, and still later triple chloride of Thiess (NaCl, KCl, CaCl₂), which he regards as isotonic with blood serum The quantitative composition of this formula is NaCl, 0.85 per cent, KCl, 0.03 per cent, CaCl₂ 0.03 per cent This solution has been used for years in the clinic of Poppert, of Giessen, and other German clinics with seemingly satisfactory results (Duttman) The objection to all these solutions in their application to the conditions which we are now considering lies in their chloride content

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and in their tendency to produce salt retention and its consequent dangers, when continued for a long period of time.

Glucose These disadvantages and dangers do not apply to glucose Gaule, a Swiss surgeon, was probably the first, in 1885, to substitute sugar or glucose for salt in hypodermoclysis Friedrich and Lennander, as previously stated, advocated glucose in 1905 for hypodermoclysis. Glucose was also recommended by Kausch, in 1911, for both intravenous infusions and hypodermoclysis; and by Kuhn, in 1911-1917, as an intraperitoneal infusion and for hypodermoclysis and intravenous use Through the publications of these surgeons, which showed the superiority of glucose over salt in its nutritive, stimulating, diuretic and antithrombotic properties (Kuhn), I was led to the use of glucose in 5 per cent. solution, which Kausch had recommended as isotonic for hypodermoclysis Recently, Duttman, of Poppert's Clinic, Giessen, after a very painstaking comparative study of salt and glucose solutions (he states that a glucose solution, 4.15 per cent, is as isotonic to the tissues and blood as a 0.9 per cent. salt solution), concludes that the prolonged or copious administration of salt is dangerous or, at least, disadvantageous in starving or fasting subjects, not only because it leads to sodium chloride retention in the tissues, thereby favoring oedema, and because of its degenerating effect upon the heart muscle and kidneys, but is also undesirable because it does not relieve the acidosis which is the invariable accompaniment of starvation.

The chief superiority of glucose over salt lies in its high nutritive food value as a foodstuff If we roughly estimate that a 5 per cent. solution of glucose is equal to 50 gm of glucose to the litre, then 4 litres, or 4000 c c of the solution administered by the intravenous drip in the twenty-four hours, will amount to 200 gm of glucose (about 7 ounces) in the twenty-four hours When estimated in calories (1 gm. of glucose = 3.75 calories Sherman), 1000 c c of a 5 per cent solution of glucose would equal 187.50 calories, and if 4 litres are administered in the twenty-four hours, 750 calories would be consumed per day

Budinger's experiments, quoted by Duttman, have shown that sugar quickly disappears from the blood and causes an appreciable stimulation and increase in metabolic rate, as shown in the great excretion of phosphates and urates in the urine The body utilizes it without any residue and when introduced in isotonic solution causes no glycosuria. In our experience it is not unusual for sugar to appear in the urine of patients to whom we have administered the 5 per cent. solution continuously by drip even for four, five or more days On the other hand, when denser solutions have been used for diuretic purposes in infusions of from 300 to 500 c c. of a 30 per cent concentration (Enriquez's solution), a slight temporary glycosuria has been observed, but solutions of this concentration are very rarely used and only when urinary suppression is threatened, especially since Guiraud's observations § have shown

§ Paris med, July 25, 1914

that the infusion of such solutions may be followed by serious metabolic disturbances and toxic symptoms

Woodyatt and his associates, Sansum and Wilder, in their remarkable experimental studies on the effects of "Prolonged and accurately timed intravenous injections of sugar," in which the questions of the rate of infusion, sugar tolerance and utilization, are especially considered (Jnl A M A, Dec 11, 1915), determined "that 0.85 gm of glucose per hour for each kilogram of body weight can be given indefinitely without glucose appearing in the urine" Among other deductions they conclude that "a man weighing 70 kg when resting quietly may receive and utilize 63 gm of glucose by vein per hour without glycosuria He then receives 252 calories per hour, a rate corresponding to 6048 calories per day If his resting requirements were 3000 calories per day he would thus receive double what he needed or enough to cover the caloric expenditure of the same man during heavy physical exertion Intravenous nutrition with glucose is thus proved to be a feasible clinical proposition and the way is open for experiments with amino acids, polypeptides, etc"

Since in our practice with the continued drip we have utilized only a 5 per cent glucose solution and have rarely exceeded 5000 cc of the solution in the twenty-four hours, it follows that the maximum dosage of glucose obtained in the twenty-four hours would only exceed a fraction over 10 gms per hour, which is less than one-sixth the quantity that Woodyatt estimates can be utilized by the organism in normal individuals, without glycosuria. This accounts for the rarity of glycosuria in our patients though the conditions under which the drip was administered are very different and less favorable for sugar utilization than in normal individuals The field is open therefore for clinical observation, especially now that insulin is available to utilize any excess of sugar that may be indicated in the urinary overflow, for its food value

My experience, as a whole, leads me to agree thoroughly with Duttman's conclusions that an isotonic glucose solution should be preferred to saline solutions in all cases in which a parenteral supply of fluid and food is needed by fasting, shocked and exhausted subjects Furthermore, I would add that a 5 per cent glucose solution is isotonic and is especially indicated when an artificial serum for blood replacement is to be administered for long periods of time, as by our continuous intravenous drip method And, again, glucose is especially indicated in patients suffering from renal or cardiopulmonary lesions in whom salt retention is most dangerous

19 *Adrenalin* As an efficient adjunct to glucose solution in stimulating the myocardium and in raising the blood-pressure we depend upon adrenalin, 1 to 1000 solution It rightfully claims the first place in artificial stimulation by the intravenous route when injected cautiously as needed, in accordance with the indications furnished by the pulse and blood-pressure The adrenalin solution is injected, drop by drop, with a hypodermic syringe, the needle being inserted into the vent of the Murphy tap, or by the Crile method, directly into the delivery tube near the cannula One drop is injected at a time and the effect carefully noted If the usual marked effect in improving the pulse is observed, the adrenalin is discontinued As a rule, not more than 5 to 10 drops are injected at a time in sequence The adrenalin is repeated only according to indications furnished by the pulse and blood-pressure Usually after a decided effect is obtained by the adrenalin the continued glucose drip suffices to maintain the improved quality of the pulse

We have seen no advantage in the continued administration of the adrenalin as a permanent infusion mixed with the glucose solution. In Germany, a great deal of stress is laid upon the continuous administration of the adrenalin, and it is given mixed with the salt solution (which is still used in most clinics) in the proportion of 1 c.c. of the 1 to 1000 adrenalin to the litre of the normo-sal solution. (Wiedhopf and Hilgenberg.) In our practice the interne or nurse is instructed to administer the adrenalin only when the pulse is growing more rapid and shallow. The main reliance is placed upon the stimulating and blood-replacing effect of the glucose solution alone when it is continuously applied by the drop method. Other drugs, such as pituitrin, morphine, the soluble digitalis preparations, strychnine and caffeine are administered by injecting them directly into the Murphy tap or into the rubber tube which delivers the glucose solution into the circulation. Camphor oil we use frequently, but only subcutaneously.

Oxygen We have had no experience with Kuttner's suggestion that the solution used for an infusion can be improved by oxygenating it. On the basis of his experiments, 1 litre of normal saline solution can take up and hold 20 c.c. of O_2 . This suggestion strikes me as rational and well worthy of consideration, but in the conditions in which we have resorted to the continued intravenous drip we have not found it practical to extemporize the oxygenated solution, though it would appear quite feasible to prepare it in prolonged cases. Presumably glucose solution could be saturated with oxygen as well as salt solutions, but it will require further experimentation and clinical experience to determine its practical advantage ¶

Results Wiedhopf and Hilgenberg, operating for septic peritonitis from various causes in Lawen's Clinic (Marburg), applied the intravenous drip in 52 cases which had been recorded in that clinic during the last two years (up to the date of their publication, in 1923). They used saline solution (Straub's formula) in combination with adrenalin in the proportion previously stated. Ten of these patients died within the first twenty-four hours. These patients were regarded as inoperable, practically moribund, but the operation was risked in spite of the bad prognosis, presumably the improved circulation obtained by the drip justifying the intervention. In 25 cases the collapse was caused by peritonitis. The majority of the cases were infused ("dripped") after operations for peritonitis caused by appendicitis, a few were perforating gastric ulcers or ruptured gall-bladders. Post-operative failure of the circulation was the chief indication for the intravenous drip in 19 cases. The total mortality and causes of death are not stated.

My personal experience with the intravenous drip, though it goes back to 1911, does not exceed 26 cases. We began, as previously stated, with

¶ Friedemann (Zentralbl. f. Chir., 1921, No. 4, p. 114) has put in practice Kuttner's suggestion and described an ingenious electric-heating apparatus to which is attached an oxygen cylinder. A stream of the gas is run through a normal saline solution in the warmed receptacle. He has applied this successfully in one case of ruptured tubal pregnancy, the solution being infused for nine hours by the intravenous drip method.

saline solution, 0.7 per cent, but after the first few cases we substituted glucose, 5 per cent, and have continued this solution to the present time. In the beginning and up to the last few years we resorted to the intravenous drip only in very exceptional, unusual and desperate cases. More recently, as our experience has increased and we have gained more confidence in its safety, we have enlarged its field of application and applied it with greater frequency. Owing to this exceptional and restricted use to the gravest cases, the total mortality has not been less than 60 per cent. The comparatively small number of cases in which the method has been applied in our clinic is accounted for by the fact that the majority of our cases have been treated for conditions for which the usual methods of proctoclysis, hypodermoclysis or a single intravenous infusion or blood transfusion have sufficed to meet the immediate indications. In a large emergency hospital or ambulance service the indications for intravenous drip would be, I am sure, enormously increased, to the great advantage of the patients.

I regret that I have not been able to tabulate the number of cases treated in my service with all the details necessary for an accurate report, but I am gathering all the available records of patients operated by myself and other colleagues who have adopted the method, with the expectation of the early publication of a detailed report. Suffice it to say that in the extremely grave and complicated (and too often hopeless) cases in which I have resorted to the drip in the past the mortality rate is necessarily very high and that the failure of the drip to save life is no criterion of its efficiency or inefficiency except for the particular purpose for which it is applied. In addition, the proper and safe application of the intravenous drip for protracted periods of time demands the constant and vigilant attention of thoroughly intelligent and competent attendants who are not always available. A few examples would suffice to show that in spite of a revived circulation, well sustained by the intravenous drip, death will inevitably occur when irreparable damage has been inflicted upon the organism in any of its vital parts. For instance

A man, aged fifty-one years, was admitted to my service at the Touro Infirmary in April, 1913, suffering with a strangulated inguinal hernia. I had to resect two feet of gangrenous gut. The continuity of the resected bowel was restored by a circular enteror-rhaphy. The patient recovered from the operation and was improving, when he developed an acute gangrenous cholecystitis which had been latent for years. The gall-bladder was promptly drained and two calculi removed. The gall-bladder had perforated and a quantity of pus and bile had escaped into the peritoneum. An intravenous drip was instituted and the patient rallied and was seemingly recovering after consuming more than 8000 c.c. of glucose solution. On the fifth day, however, he suddenly developed cerebral symptoms and died in profound coma. The post-mortem revealed a large cerebral abscess which had ruptured into the lateral ventricles, flooding them completely with foul, colonic pus. Here the circulation was well maintained up to the last few hours before death.

In another instance, a woman, aged thirty-two years, suffering from an obstructing rectal carcinoma, was operated on June 10, 1922. An artificial sigmoid anus was created as a preliminary to a radical amputation of the rectum. The operation presented no unusual features and the post-operative sequelæ were uneventful until the fourth day,

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when she suddenly collapsed, with excruciating pains in the abdomen and signs of acute intestinal obstruction. The circulatory collapse in this case was profound and death seemed imminent. A glucose intravenous drip was started at once and the patient warmed up and rallied promptly. The abdomen was then opened and a coil of gut, representing the greater part of the jejunum, was found strangulated in the left para-duodenal fossa of Treitz. The gut was extracted with great difficulty from this pouch, and when exteriorized was found to be cyanotic, purple and with a number of suspicious spots suggesting the beginning of necrosis. By pouring pitchers of hot salt water over the gut the color and motility improved sufficiently to justify us in replacing it in the cavity. The artificial anus at the sigmoid, made five days previously, was now functioning actively and discharging quantities of gas and fluid faeces. Through this ordeal the pulse was remarkably well sustained and gave us no anxiety, the intravenous drip continuing uninterruptedly all the time. Nonetheless, and in spite of the remarkably good pulse, the patient died on the fifth day. The necropsy showed that death had been caused by mesenteric thrombosis and consequent gangrene of the gut in patches.

In this case the patient consumed in six days, beginning with the collapse, 14,800 c c of a 5 per cent glucose solution, or nearly 15 quarts, of which 2000 c c were of 0.7 per cent saline, all administered by the intravenous drip with the intermittent addition of adrenalin drops, as these were specially indicated. In this case the drip more than filled our expectations in holding up the circulation to a remarkable degree. Toward the end, while the pulse held well, the respiration became shallow, intermittent and failed before the pulse gave way. No wonder that under such overwhelming sepsis the most effective support to the circulation was of no avail. In this case the Jutte tube in the stomach was of immense service in preventing vomiting and keeping the patient comfortable by constant gastric lavage and drainage.

On the other hand, the value of the intravenous drip as a life-saving measure is shown in a more favorable light in the following case.

A farmer, aged forty-eight years, tall, profoundly anæmic, almost marasmic from long fasting and intestinal hemorrhage, was referred to me in April, 1918, with a diagnosis of duodenal or gastric ulcer. He had been in the infirmary scarcely two days while undergoing preparation for operation, when he developed all the signs of an acute peritoneal collapse. The abdomen was promptly opened and a perforating ulcer of the first portion of the duodenum was recognized. The extravasated duodenal contents were carefully wiped out and the perforation closed by suture of the partially excised and inverted edges. A single massive intravenous glucose infusion rallied the patient and he seemed to be recovering, but on the fifth day signs of suppuration in the right hypochondrium with diaphragmatic pleurisy appeared. The patient, who had been dieting for many months before the operation, was exhausted and extremely emaciated. At this juncture his pulse began to show signs of a progressive and alarming weakness. A continuous intravenous drip was now instituted, and following its good effect a large collection of pus was drained from the subphrenic space by a transpleural thoracotomy, to do this effectively the ninth and tenth ribs had to be resected. The patient could now scarcely nourish on account of the constant regurgitation of the gastric contents. His anal sphincter was too weak to retain the rectal drips and systematic hypodermoclysis failed to improve his circulation. The continued intravenous drip gave us the only hope to supply him with fluids and food, and after this had been instituted it was allowed to continue unremittingly for five days, when he began to retain water and nutritive fluids by mouth. The pulse, which had been reduced from 140 to 150 to 110 by the drip, then continued to retain its good quality after the drip had been temporarily interrupted.

to test the improved stability of the pulse. In view of the continued improvement of the pulse the cannula was removed from the vein and the drip permanently discontinued. During the five days that the drip had been in operation the patient had consumed 22,000 c c of glucose solution. The patient finally recovered after a long convalescence. He returned on June 22, 1920, with a cicatricial stricture of the duodenum, which was completely relieved by a posterior gastro-enterostomy. He has since been heard from, expressing himself as perfectly well and attending to his usual occupations. In this case blood transfusion was indicated even before the perforation of the duodenal ulcer had occurred, but it is doubtful that it would have had the permanent stimulating and nutritive effect that the continued glucose drip exercised during the prolonged period of exhaustion and gastric intolerance for food and drink that this patient displayed after the operation.

In another and more recent case the intravenous drip carried the patient through a critical period of collapse from hemorrhage and permitted a Cæsarean section to be done, with recovery without recourse to blood transfusion.

Mrs F, primipara, aged twenty-five years, was admitted to the Touro Infirmary on July 15, 1923. She had arrived nearly at term, but was suffering from frequent and copious hemorrhages caused by placenta previa. Efforts to dilate and deliver by podalic version had been made by her attending physician, Dr F Larue, but the deluge of blood that followed compelled a hasty tamponade, which had to be renewed on account of the constantly recurring hemorrhage. It was decided that a Cæsarean section was necessary, but the patient was so bleached and collapsed from hemorrhage and exhaustion that we proceeded with an intravenous glucose drip, pending the typing of the husband's blood preliminary to transfusion. The transfusion, however, was postponed and not carried into effect, as it was not found necessary. The pulse was steadily growing weaker and the hæmoglobin had fallen to 60 to 50 per cent. Under the influence of the continuous intravenous drip the pulse improved and we were able to deliver a dead fœtus without great difficulty. The cannula was allowed to remain in the vein and the drip was continued all that day, when the pulse and general condition had improved so much that the drip was discontinued. In the course of twelve hours the patient had received 3800 c c of 5 per cent glucose with several intermittent additions of pituitrin and adrenalin. She was fortunately able to nourish and drink by mouth, and in this way made an excellent recovery and was discharged well, though still slightly anæmic, twenty-one days after her delivery.

In this case the glucose drip allowed us to dispense with what seemed at first to be a necessary blood transfusion.

The preceding cases, which have been merely sketched in outline are quoted to illustrate the class of patients in whom we have resorted to the intravenous drip, but they could be multiplied many times over if space would permit a detailed account of the 26 patients in whom we have found this measure specially indicated. In view of the desperate character of all of them, it is not surprising that fully 60 per cent succumbed to the primary or secondary causes that brought the patients to the operating table. If the continued intravenous drip had been used as a routine method in the class of patients in whom we still use proctoclysis, hypodermoclysis or massive infusion or transfusion the intravenous drip would indeed make a most brilliant showing. Thus far we have limited the application of this method to the cases in which other procedures requiring less vigilance, prolonged attention and intelligent discretion on the part of the attendants suffice, ordinarily, to meet the indi-

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cations There is no reason why the intravenous drip should not be extended with advantage to a far greater number of indications provided competent assistance is available.

In conclusion, allow me to repeat that for certainty of dosage, promptness and duration of effect in sustaining a weak or failing circulation none of the methods of cardiovascular stimulation at present in vogue can compare with the continuous intravenous drip. When glucose is made the basis of the infused fluid, the continued intravenous drip is incomparably superior to all the other methods of parenteral nutrition and medication, as it supplies continuously an easily assimilated foodstuff in isotonic solution for an indefinite time. In this way, it serves the purpose of a blood-replacing and nutrient fluid, constantly supplied, in addition it is a cardiovascular stimulant, a diluent (of toxins and catabolic products), an eliminant (especially by the renal route) and a neutralizer of the acidosis which is present and so often adds to the dangers which beset the precarious existence of the patients now under consideration.

REFERENCES

ON INTRAVENOUS DRIP

- Duttmann, G. Bruns' Beitrage, 1923, No 1, vol cxxviii, p 68
Friedemann Zentralbl f Chir, 1913, p 1893, Deutsch Ztschr f Chir, 1919, vol cli, p 352, Zentralbl f Chir, 1921, p 114
Friedrich On Artificial Subcutaneous Feeding in the Practice of Surgery Langenbeck's Archiv, 1904, vol lxxiii, Trans First Int Cong Int Soc Surg, Brussels, 1905, p 10 (Discussion on the Treatment of Peritonitis)
Godard La cure de dechloruration, Thèse de Paris, 1904
Kausch Deutsch med Wchnschr, 1911, No 1, *ibid*, 1917, No 25, Munchen med Wchnschr, 1916, No 15
Kuhn Deutsch Ztschr f Chir, 1913, vol cxxii, p 90
Lennander Discussion on Peritonitis, Trans First Int Cong Int Soc Surg, 1905, p 38
Matas, R. A Clinical Report on Intravenous Saline Solution in the Charity Hospital, New Orleans (1881-1891), New Orleans Med and Surg Jour, July-August, 1891
Penfield, W G, and Teplitzky, D Archives of Surgery, 1923, No 1, vol vii, p 111
Thalheimer, W Jour Am Med Assn, 1922, vol lxxviii, p 190
Thiroloux, M J Bull et mém Soc méd des hôp de Paris, December 7, 1922, 3d series, p 34
Unger, E, and Heusser, H Thérapie d Gegenwart, 1923, vol lxiv, pp 15-18
Widal and Javal Bull de la Soc méd des hôp de Paris, June 26, 1903
Wiedhopf, O, and Hilgenberg, F C Bruns' Beitrage, 1922, No 1, vol cxxvii
(A valuable list of references to the German literature on the continued drip is given in the last article)

ON GASTRIC AND TRANSGASTRIC INTUBATION APPLICABLE TO SURGICAL PRACTICE

- Bassler Southern Med Jour 1919, vol xii, p 4
Carnot and Liebert Paris méd, 1922, No 13, vol xii
Heller, E P Therap Gaz, Detroit, 1922, vol xxxviii, p 461
Jutte, M E Jour Am Med Assn, 1913, vol lx, pp 586, 687, Am Jour Med Sci, 1917, vol cliii, p 732
Levin, A L Southern Med Jour, July, 1920, No 7, vol xiii, p 490 ¹Levin has recently modified the Jutte tube with special advantage for the purposes recommended in this article (see Jnl A M A, 76, 15, April 9, 1921, p 1007)
Oden, C L A Surg Gynec and Obst, 1923, vol xxxvi, p 572

SOME PROBLEMS OF JAUNDICE AND THEIR SIGNIFICANCE IN SURGERY

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THE diseases of the liver and in connection with them the problem of jaundice have recently aroused greater attention. New investigations deepened our knowledge of jaundice and made it possible to distinguish different groups. It is my aim to show in this paper, how we can use these new methods in surgical diagnosis and in our operative indications.

What is jaundice? It is the partial or complete retention of bile constituents in the organism. This definition involves two facts: that yellow skin or sclera caused by other than bile-pigment must be excluded from the conception of icterus—as for instance, the yellow color of diabetic and arteriosclerotic patients caused by increased lutein-index of the blood and tissues, or the yellow color of patients after intravenous injections of tyroflavin, all conditions that might be the cause of error, when preliminaries are unknown. The second conclusion we are able to draw from the above definition is a distinction between two kinds of icterus. The one—*complete icterus*—is present, when all bile-constituents are circulating in the blood, also not only bile pigment, but bile-acids, cholesterine and besides other products of decomposition, that usually leave the organism with the bile. This complete icterus can be called *cholæmia* in the sense that all constituents of the bile are circulating in the blood. In contrast with this kind of jaundice we can discern a partial retention, or as the French school calls it, dissociated icterus, when only the bilirubin circulates in the blood and all other constituents are missing. Cases are described, when only the excretion of bile acids is disturbed. In my personal opinion this bile-acid icterus is only apparent and is the consequence of the different elimination index of bilirubin and bile-acids. To explain this statement in other words, while the bilirubin must attain the concentration of 1.5–2 mgr. per cent. in the blood to be able to pass through the kidneys and color the tissues, the biliary acids immediately pass the kidney as soon as they appear in the blood. This explains why generally no visible jaundice develops after a biliary colic, but bradycardia, skin itching, diminished surface tension of the urine can be observed, all signs, that the excretion of biliary acids is disturbed. And still we cannot regard this as a case of dissociated icterus, because biliary pigment is retained too, although in a concentration not high enough to appear in the tissues. I have to state that this principle difference between the elimination of biliary pigments and acids has not been noted and valued in literature.

Now in contrast to *cholæmia*, we can call the dissociated icterus a *bilirubinæmia*, the pigment retention alone being possible; the isolated retention of cholic acids is not sufficiently proved.

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Hymans van der Bergh and after him Lepehne succeeded in distinguishing clearly two kinds of jaundice by the help of a simple chemical reaction. In every case, where jaundice had a mechanic cause, this reaction took place immediately, without the addition of alcohol, while in cases where no impediment in the bile flow could be found (no obturation, obstruction or compression of the bile passage) the chemical reaction could only be obtained immediately in the presence of alcohol; on this basis they distinguished a mechanical and a functional bilirubin in the blood, the latter being the result of functional incompetency of the liver cells to excrete the normal amount of bilirubin, or, on the other hand, an increased pigment production in the reticulo-endothelial system. Lepehne showed that both groups can appear at the same time, when both factors, mechanical and functional are present.

It is easy to see that complete and partial icterus or cholæmia and bilirubinæmia correspond exactly to mechanic respectively functional icterus. In other words, that the different chemical behavior of bilirubin, explained by Hymans van der Bergh as a different chemical activity of the same pigment, ought to be explained by the presence of the other bile constituents, cholic acids and cholesterine. Yet experiments *in vitro* had negative results. The difference between mechanic and functional bilirubin turned out to be the question of whether the pigment has passed the liver or not, whether it is freed from its albumen by the liver or not. It was possible to turn functional bilirubin into a mechanical one, by digesting the albumen in a thermostat with pepsin, which experiment is of great theoretical importance.

After this short resumé let us proceed to see the practical use of the above considerations. What is jaundice clinically? It is a symptom, not a disease, it can be caused by any disturbance in the bile passage, by the insufficiency of liver cells and by the hyperfunction of the reticulo-endothelial system. It is of greatest practical importance to be able to distinguish the different sorts of jaundice before an operation. It cannot happen then, that a case of hæmolytic jaundice—a disease accompanied by jaundice and colic—should be taken for gall-stones. Until now the diagnosis of jaundice was simply based on the yellow color of skin and scleræ, the contents of urine in cholic acids and pigments. The analysis of blood concerning bilirubin is a simple test, that helps to detect icterus in cases, when the bilirubin is neither visible in the tissues, nor has appeared in the urine, because it has not attained the concentration of 2 mgr per cent in the blood. Examining blood in cases one or two days after the biliary colic, I succeeded each time in demonstrating increased bilirubin index in the serum, although neither scleral icterus nor any pathological contents of the urine could be found; one can also find more cholesterine in the blood after every biliary colic. This latent icterus can be of great diagnostic help in cases of colics with unknown origin. Further, the importance of minimal degrees of hæmolysis, also to be detected by slightly increased bilirubin index can be of high importance for indication to splenectomy. In cases of visible let us say *manifest icterus*, it is the quality of

icterus that will interest us Is it a cholæmia or is it a bilirubinæmia? This will decide the quality of the operation and will guide our pre-operative preventive measures The liver, heart and kidneys of icteric patients must be carefully examined We know, too, that even purely mechanic jaundice leads sooner or later in consequence of the increased bile tension to functional disturbances of the liver, anatomically to biliary cirrhosis On the other hand, functional icterus, bringing constantly more pigment to the liver, than it is able to work off, cannot be harmless to liver cells

Now besides these secondary liver alterations, the knowledge of primary liver diseases is extremely important for the surgeon, partly because they might be the cause of diagnostic failures (lues hepatis, subacute liver atrophy taken for gall-stones) and partly on account of the narcosis Chloroform is a well-known liver poison, that can produce in people with seemingly intact liver, acute yellow liver atrophy On the fourth to sixth day after the operation the patient gets icteric, symptoms of vomiting, colic, delirium appear, and lead to death The post-mortem shows a severe fatty degeneration of the liver If death takes place a little later, centroacinous necrosis is the most evident symptom Icteric patients should never get a drop of chloroform, even ether is to be avoided if possible By a local anæsthesia of the abdominal wall with intercostal injections on the right side and eventually splanchnic blockade combined with a short ether, or etherchlorid—Rausch—any operation on the biliary or splenic system can be performed Even so, as my statistics will show, the degenerated liver, heart and kidney, prove to be insufficient in an astonishing percentage of cases The heart is attacked by the cholic acids These poisons are very closely related to digitalis and lead to myodegeneration, the epithelium of the tubuli contorti in the kidney degenerates and proves insufficient at the slightest stress Here is the essential difference between cholæmia and the bilirubinæmia While the bilirubin is only a harmless pigment, the cholic acids are poisonous for heart and nervous system and play an important part in the digestion of fat Brule's cholic acid test is based on this latter fact

A most important question is the relation of the jaundice to hemorrhage The hæmostasis in wounds depends less on coagulation than in first line on the agglutination of blood discs, this can be controlled by Duke's test Duke's bleeding time, normally two to two and one-half minutes, can be easily determined anywhere without special technical arrangements The prolongation of bleeding time by normal coagulation is a symptom of thrombopenia That is why patients suffering from pernicious anæmia bleed so profusely One finds on the contrary, in spite of a normal number of thrombocytes, long coagulation and long bleeding time in cases of hæmophilia, cholæmia, hirudin and phosphor-intoxication, in these cases the fibrin-production of the liver seems to be disturbed Finally we can examine the condition of the blood-vessels, as regards their endothelium, by tying the arm up tightly for ten minutes and looking for tiny subcutaneous hemorrhages (endothel symptom) The practical conclusion for surgeons is that if Duke's test (bleeding time)

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is normal, we need not care for the coagulation time or for the endothel symptom, because every toxic agent that prolongs coagulation time acts upon bleeding time, too. The contrary, long bleeding time with normal coagulation, exists, and is characteristic for thrombopenia. We present on Table I the hemorrhagic conditions of 17 icteric patients (Table I.)

The long bleeding time in cases of cholelithiasis with jaundice always means disturbed liver function and goes together with Vidal's "*crise hémoclasique*" We give in every case of jaundice, where bleeding time is longer

TABLE I

Diagnosis		Number of cases	Bleeding time	Coagulation time	Endothel symptom	Vidal's <i>crise hémoclasique</i>
Cholæmia	Cholelithiasis	6	normal	normal	—	—
	Cholelithiasis	4	long	long	—	+
	Cirrhosis Hanot	1	long	long	—	+
Bilirubinæmia + thrombopenia	Ict hæmolyt	3	long	normal	—	—
	An perniciosa	3	long	normal	+	—

than two and one-half minutes, 1 gramme of calcium bromid *intra venam*, three days long. Serum and gelatine can be given, too, but personally I would prefer calcium. X-raying spleen and liver for hæmostasis could be tried. We have no personal experience of this method. Opinions seem to be divergent concerning its efficacy. Since we have been preparing patients during three days with calcium, we have lost no patient by post-operative hemorrhage, at all events, the shortening of the bleeding time shows best the value of these injections.

As to the surgical treatment of the different kinds of jaundice. In cases, where there is obstruction in the bile passage, we try to remove the obstacle, the cause of occlusion, obturation, constriction or compression. If this proves to be impossible, we try to connect the biliary system above the obstacle with the gastro-intestinal tract, if this also is not possible, we will make an external biliary fistula and give bile extracts internally.

It would transgress the extent of this paper to discuss the results of our gall-stone operations. I will only give the numbers as far as they are connected with jaundice. In Table II, I divide all cases of gall-stones into three groups (Table II.)

I. *Simple cases*, where the process has not transgressed the gall-bladder,

also *hydrops* or even *empyema vesicæ felleæ*, without notable adhesions in the surrounding parts

II *Complicated cases* I understand serious adhesions, exuberations, fistulas, and conditions that make an intervention of the deeper biliary passages necessary, but no apparent jaundice exists. Stones in the choledochus, moving freely, and not definitely hindering the bile flow, belong to this group

III In this group I place all jaundiced gall-stone cases. The mortality of this group is 36 per cent. But if we select the cases where jaundice lasted

TABLE II
Gall Stone Cases from 1914-June 1922 (I Surgical Clinic, Budapest)

Cases	Number of cases	Mortality	%
I Simple cases	129	2	1.5
II Complicated cases no icterus	139	7	4
III Icterus	63	23	36
Icterus not lasting a month	36	9	25
Icterus over a month	27	14	55
Total	331	32	9

Tumors (malignant) of biliary tract

I No icterus	6	1	17
II Icterus	9	4	45
Total	15	5	33

less than a month in contrast to cases lasting over a month, we find the astonishing numbers of 25 per cent and 55 per cent. This latter percentage explains the endeavor of surgery to treat jaundiced patients, if short internal treatment has proved to be useless, surgically as soon as possible. Of course one will willingly wait after a biliary colic that appears with jaundice for some time, as 30 per cent of all patients suffering from cholelithiasis have jaundice in their history, and it is better to wait for an interval before operation, as the mortality of the operations during the attack is just double, but it is the greatest possible mistake to wait longer than four weeks, as our numbers prove.

The so-called prophylactic operations, proposed lately by several authors in analogy to appendicitis, are superfluous in my opinion, because the gangrene, the perforation of the gall-bladder, occurs in a very low percentage of cases, and always has its alarming symptoms. We operate on gall-stones

not speaking now of acute inflammatory and obstructive cases when a rational medical treatment does not bring the process to a latent state, in other words, if the treatment does not succeed in curing the inflammation. This should be the territory of internal treatment, the mechanic factor cannot be influenced till now medically.

The treatment of liver diseases accompanied by jaundice is not in the surgeon's line, but of course all secondary liver-cell disturbances, that arise through congestion of bile or increased pigment production, can be improved or quite cured by removing the original cause. It has been further proved that the increase of liver diseases in defeated countries is caused by the diminished glycogen contents of the liver. Roger recommends a copious supply of carbohydrates for patients suffering from insufficiency of the liver. I have personally tried to overcome the liver incompetency on our last five cholæmic patients by giving intravenous and rectal infusions of glucose, the results are very promising. The sugar has a favorable effect in every respect. It is the best nutrition for the heart, it supplies the liver with glycogen, it works against post-operative acidosis that is especially excessive in cases of jaundice and is still increased by calcium given as a hæmostatic.

The knowledge of functional disturbances of the liver is eminently important for the surgeon. Unfortunately, the functional tests known till now, are neither simple nor quite reliable, besides, considering the manifold functions of the liver, one test can never be sufficient. In regard to the chologen functions of the liver, I found the ratio of the serum and bile concentration of bilirubin, a very fine indicator of hepatic function (Hetenyi's test). The test is especially useful in cases of functional jaundice and of course quite useless in absolute obstruction, where no bile can be obtained with the duodenal tube. I would like to insist upon the fact that as the mortality of operations on the urinary tract sank after the systematic employment of tests for kidney function, so could we reduce the enormous mortality of obstructive, although not malignant, jaundice, if we were aware of the condition of the liver. In the presence of high degrees of hepatic insufficiency one could previously make a biliary fistula, and freeing the liver cells from the great bile tension, give them the possibility to resume their function, every surgeon has seen cases of obstructive jaundice with seriously afflicted, cirrhotic livers, heal with absolute restitution after the removal of the mechanic obstacle.

Lately an effort has been made to cure hypertrophic and atrophic cirrhosis of the liver, especially cases with enlargement of the spleen with splenectomy. On the other hand, one tried to discharge the afflicted liver in cases of acute and subacute yellow liver atrophy with choledochotomy. Our own experience is much too small to enable us to form a definite opinion concerning these operations.

Syphilis of the liver sometimes makes diagnostic difficulties and it must not be forgotten that every icteric blood serum can give a positive Wassermann test without any luetic infection.

The third group of jaundice, that of hæmolytic origin, has lately given the greatest surgical results. Every hæmolytic icterus should be operated on as soon as possible, pernicious anæmia only if hæmolysis can be shown (increased bilirubinæmia). In diseases belonging to this group jaundice disappears in a short time after splenectomy. I tried to show above that the bleeding of such patients is of quite another origin than those attained by cholæmia. The latter is the result of disturbed liver function, while the former is caused by a reduction or absence of blood plates (thrombocytopenia). Splenectomy has here a marvellous effect, the number of thrombocytes can increase from 30,000 to 300,000. Clinically the diagnosis is made by following observations: long bleeding time, positive endothel symptom, normal coagulation.

The following Table III shows our surgical results concerning functional icterus. In operating for pernicious anæmia we must be careful to exclude all cases of aplastic anæmia (functional test for bone-marrow, Takats), second-

TABLE III

Cases of Functional Icterus 1914-1922 (I Surgical Clinic, Budapest)

Diagnosis	Number of cases	Mortality	%
Icterus hæmolyticus	8	0	0
Anæmia perniciosa	51	20	40

The mortality of the last 20 cases 12 per cent

ary anæmia, all cases with absolute liver incompetency and all patients under 20 per cent hæmoglobin and 1,000,000 red corpuscles. With such precautions temporary results will increase.

I must mention too that several cases of hepatic and hæmolytic jaundice had gall-stones. A reason more to operate on these cases as soon as the diagnosis is made.

CONCLUSIONS

The following conclusions can be drawn from the facts above:

1 With a simple chemical reaction we can easily distinguish two groups of jaundice, that are best called cholæmia and bilirubinæmia. The first is caused by any disturbance in the bile flow or by the incompetency of the hepatic cell, the latter is an overproduction of bilirubin, in consequence of an increased degree of hæmolysis.

2 The intact liver function is of high importance for the surgeon. Its disturbance will produce a longer bleeding and coagulation time, a great susceptibility for narcotics and a marked acidosis after the operation. Therefore an exact examination of the liver function is of high importance.

3 In consideration of the eminent dangers of cholæmia, these patients should be submitted to operation as soon as possible. There is vital indication after four weeks.

SIGNIFICANCE OF JAUNDICE IN SURGERY

4 Jaundice of hæmolytic origin can be cured by splenectomy, although one might not always succeed in healing the actual disease. In cases of thrombopenia the hemorrhage ceases after splenectomy, although the increase of blood plates is only temporary.

An attempt has been made in this paper to discuss some of the questions of jaundice, that have special interest for surgery. In the present state of surgical technic, the evolution of surgical treatment should not consist of inventing new operations, but rather in possession of exact diagnostic measures to avoid the dangers of narcosis and post-operative bleeding, hand in hand with subtle control of liver function. Only so can a further improvement in our results be hoped.

INTRATHORACIC TUMORS*

EXPERIENCES WITH EIGHT CASES OF TUMOR OF THE THORACIC WALL
PLEURA AND MEDIASTINUM

BY GEORGE J HEUFER, M D

OF CINCINNATI, OHIO

AMONG a goodly number of patients with thoracic conditions which we have seen in the past few years have been eight who presented tumors of the thoracic wall, pleura or mediastinum which seemed to be operable. They were therefore subjected to operation and an attempt made—although not always successful—to remove the new growths. They form, especially from the viewpoint of the nature of the tumors, an interesting small group.

CASE I—The first case is one of intrathoracic *calcified cyst* arising from the anterior mediastinum and projecting into the right thoracic cavity. The case was reported in the *Review of Tuberculosis*, May, 1917, No. 3, vol. 1, and I refer to it again in order to report upon the end-result.

The patient was a colored man, aged fifty-three years, who entered the Johns Hopkins Hospital, October 31, 1916, complaining of pain in his right chest. The onset of his illness was stated to have occurred three weeks before, when, after lifting a heavy bag of cement, he had a sharp pain in his right side accompanied by coughing. He left his work and on the advice of his physician went to bed and remained there until his admission. Pain and paroxysms of coughing with abundant yellowish sputum were frequent. There was no hæmoptysis.

On physical examination the right chest was flattened and there was limitation of respiratory movements. There was dulness below the third rib in front and flatness below the sixth rib. Over the back there was flatness below the sixth thoracic spine. A provisional diagnosis of pleurisy with effusion over the right base was made. An attempt at aspiration, however, was unsuccessful, the exploring needle meeting an unyielding resistance. X-ray plates (Figs. 1 and 2) showed a well-defined shadow within the thorax suggesting a calcified cyst. A positive diagnosis was not made. Sputum examinations repeatedly made gave no information of value. Dermoid cyst, echinococcus cyst, encapsulated empyema and neoplasm were the possibilities suggested.

Operation was performed November 8, 1916. A long incision, encircling the right half of the thorax, was made and practically the entire ninth rib removed. The parietal pleura was stripped from the thoracic wall over a wide area to give us a better opportunity for exploration. Directly under the mobilized pleura was felt a very hard mass of large size. An incision was made through the pleura and the freeing of what was evidently a calcified mass begun. It was a slow, difficult procedure, due to the adhesions between the mass and the pleura, lung, diaphragm and mediastinum. Eventually, however, it was freed down to an area about 6 x 4 cm. in diameter, where the mass was densely adherent to the pericardium and great vessels. Here the calcified shell was replaced by fibrous tissue, and it was during the separation of this portion of the mass that some of its contents—a thin, yellowish, purulent material—escaped. It was thought advisable therefore, after removal of the mass, to drain the thoracic cavity.

Post-operative convalescence was uneventful. The wound healed nicely. The lung promptly expanded to fill the large cavity left after the removal of the mass. The patient was discharged with his wound healed.

* Read before the American Surgical Association, June, 1923.

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Comments From an operative standpoint there was nothing difficult about this case, although the enucleation of the mass and especially its separation from the pericardium and great vessels, was tedious. Simple ether anesthesia without any pressure apparatus was used and throughout there were no respiratory difficulties. The exposure through a simple long incision was adequate even for the removal of so large a mass. The diagnosis remains in doubt. The specimen consists of a calcified shell as large as an infant's head without a lining membrane (Fig. 3). The most careful examination

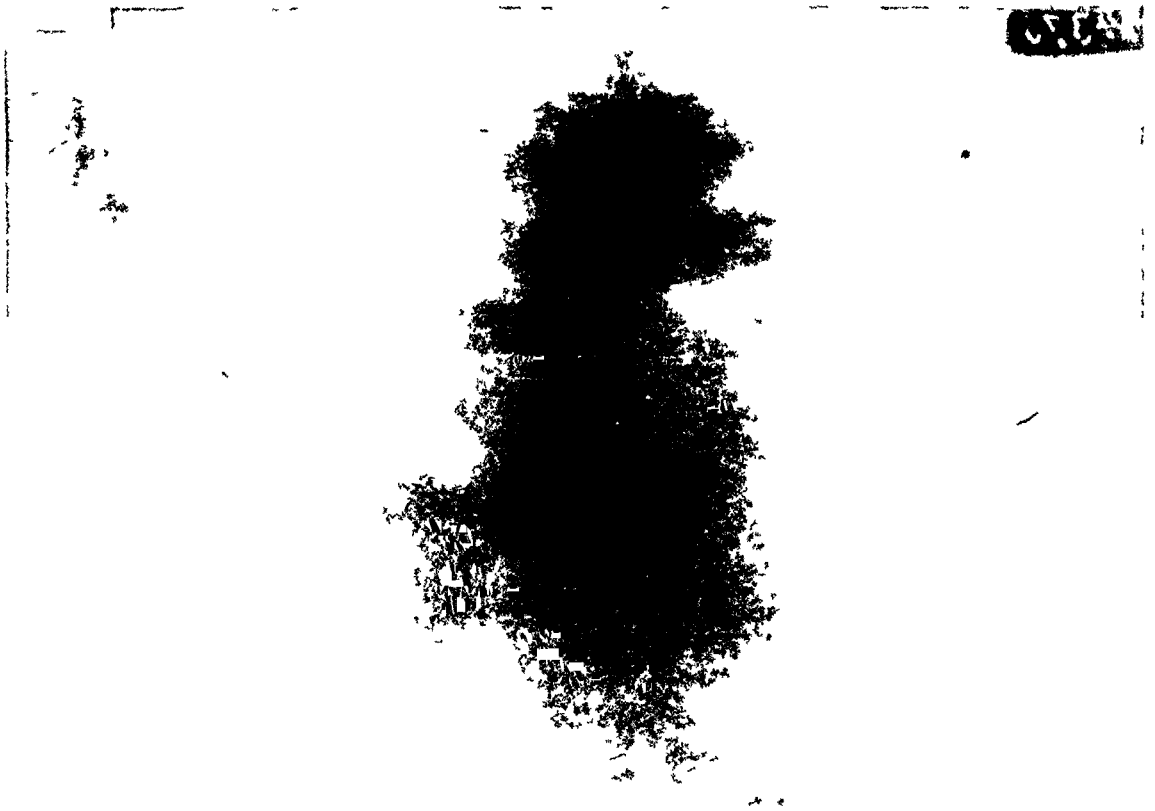


FIG. 1—X-ray of Case I showing shadow of calcified cyst in right thoracic cavity

of the contents of this shell gave us no clue as to its nature. The patient remained in good health until 1921, five years after operation, when he entered the hospital on the medical service with myocardial insufficiency. Physical and X-ray examination at that time showed some retraction of the right chest, slight thickening of the pleura and dilatation of the heart and aorta. At the present time (August 20, 1923) he reports that he is in good health.

CASE II—The second case is one of recurrent *osteocondrosarcoma* of the tenth rib involving the pleura.

A girl, aged fourteen years, was first admitted to the Johns Hopkins Hospital April 21, 1919, complaining of a tumor over the tenth rib in the posterior axillary line. The tumor was about 6 x 3 cm. in diameter, was firmly attached to the rib, was of stony hardness and slightly tender. A diagnosis of sarcoma of the rib was made and on

April 29th, Dr M. R. Reid resected a portion of the tenth rib with the tumor mass. The posterior periosteum was removed. The pleura was not interfered with. Examination of the tumor in Bloodgood's laboratory showed an osteochondrosarcoma. The patient left the hospital with her wound completely healed.

Two years later the patient returned to the hospital with a recurrent tumor attached to the proximal end of the resected tenth rib. The mass was about as large as on her previous admission. The skin over the tumor was freely movable. X-rays of the thorax (Fig 4) showed marked destruction of the rib over a distance of 6 cm. No involvement of the other ribs was discovered.



FIG 2—X-ray of Case I in the erect posture showing the fluid level

The second operation was performed June 27, 1921. The skin was widely freed over the tumor. The ninth and tenth ribs were divided well behind and in front of the tumor. The intercostal muscles and pleura were divided at the same level and a large rectangular mass of tissue, including tumor, portions of the ninth and tenth ribs, intercostal muscles and pleura, were removed.

This left a large defect in the thoracic wall about 15 cm long and in width corresponding to two ribs and three intercostal spaces. With the production of such a large opening in the thoracic wall there occurred a definite respiratory upset with cyanosis and tachycardia. The lung was quickly drawn into the opening and held there until we had decided what form of plastic procedure to use to close the opening. The diaphragm seemed the only available structure, and therefore it was drawn up to the opening and sutured to its margins. The skin was closed tightly.

Post-operative convalescence was uneventful. The lung quickly expanded. The patient was discharged apparently well. At the present time (August, 1923), two years after operation, she is without evident recurrence.

Comments The interesting feature in this case was the use of the diaphragm to close a large defect in the thoracic wall.

The opening was too low to make satisfactory use of the latissimus dorsi muscle, but not too high to make use of the diaphragm. There was no evidence at the time of the patient's discharge that the diaphragm had pulled away from its place of attachment. The respiratory upset, which occurred with simple ether anaesthesia, was not serious yet was sufficiently disturbing.

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to make it seem advisable to have at hand some form of pressure apparatus in subsequent operations

CASE III—The third case is one of intrathoracic, extrapleural xanthoma or xanthosarcoma the first xanthoma so far as I can learn from the literature to be reported in this locality

The patient, a physician, aged twenty-nine years, had for fourteen years pain of a cramp-like nature in the right lower quadrant. The pain was not associated with fever or nausea, nevertheless, in 1911, on the advice of his physician he had his appendix removed. The appendix was normal and its removal failed to relieve his pain. During his service with the army in France the pain became more severe and he was repeatedly examined. A relaxed inguinal ring with an impulse was noted and a hernia operation was suggested but refused. Cystoscopic examination, catheterization of the ureters and thorium injections of the renal pelvis with X-ray examinations failed to discover any abnormality. X-rays of the gastro-intestinal tract were negative. He continued to have pain in his lower right quadrant, but in addition began to have severe pain in his back which was called lumbago. In November, 1918 he had in fluenza and an X-ray of his chest showed a mass behind and to the right of his heart shadow. Subsequent X-rays confirmed this finding. He was explored with a needle, but the exploration was negative. On his return from France he was given radium treatment in Baltimore but without benefit. His physical examination was negative except for the tumor shown in the X-rays (Figs 5 and 6)



FIG. 3.—Photograph of calcified cyst. The defect in its wall represents the area over which it was attached to the pericardium and great vessels.

Operation was performed October 15, 1919. A long incision was made over and parallel with the ninth rib. The proximal six inches of this rib were resected and the parietal pleura stripped from the thoracic wall over a wide area. Without opening the pleural cavity the tumor was exposed. It was larger than a hen's egg, lay against the bodies of the vertebra and seemed attached to the tenth rib. The pleura was readily separated from it. Having freed the tumor down to its apparent attachment to the ribs portions of the tenth and eleventh were resected and removed with the attached tumor. The operation was completed without at any time opening the pleura. The wound was closed without drainage.

Post-operative convalescence was uneventful with the exception that the extrapleural space filled with fluid which however subsequently disappeared. The wound healed *per primam*. The patient is perfectly well and free from pain four years after operation.

Comments The most interesting feature of this case is the nature of the tumor (Figs 7 and 8) It is a typical xanthoma and the first, I think, which has been reported within the bony thorax Its origin is uncertain Its only point of attachment was apparently the tenth rib, but examination after the removal of the tumor showed that this attachment was not to the bony rib and not precisely to the periosteum At least the attachment was not such that the tumor could be said to arise from the periosteum

A second interesting feature of this case was the extrapleural approach

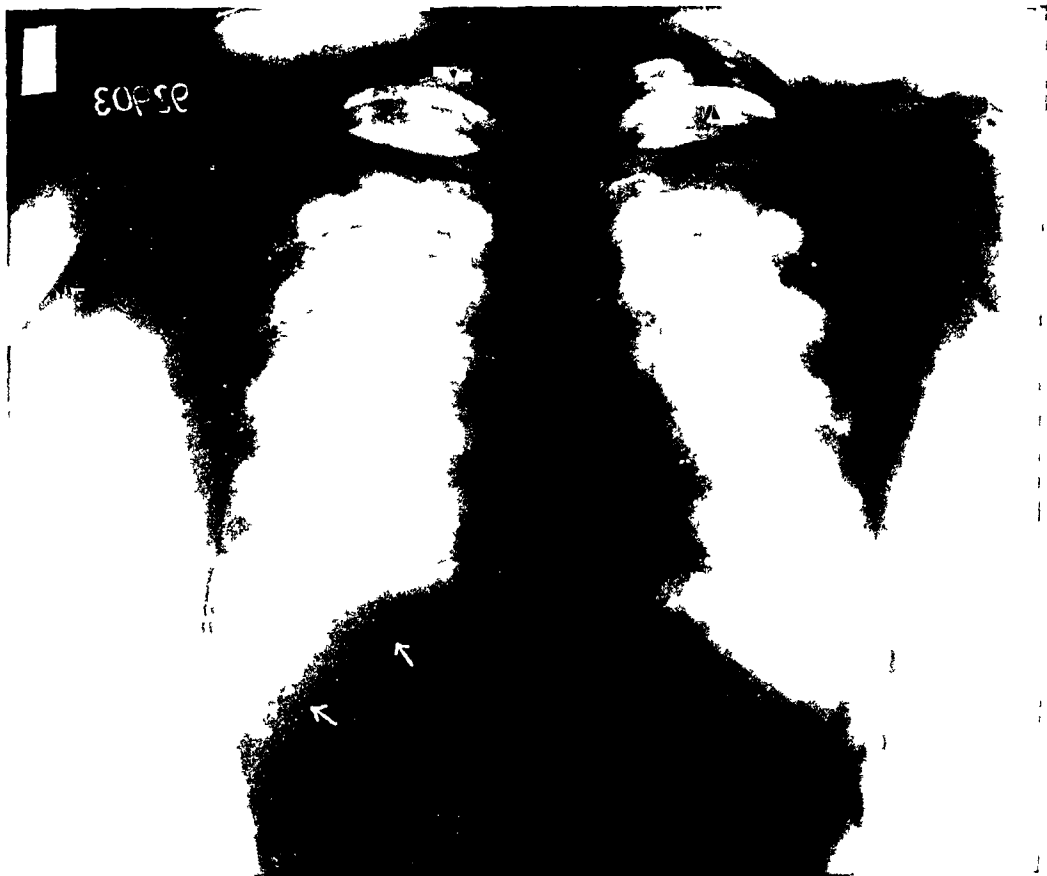


FIG 4—X-ray of Case II The arrows point to the area of destruction in the rib

and the removal of the tumor without opening the pleural cavity It has been found in approaching thoracic lesions that stripping the parietal pleura has a number of advantages It permits through the resection of a single rib a wide exploration of and an approach to lesions before the pleura is opened It enables one to determine where, if any, adhesions between lung and pleura exist In all the cases reported in this series it has proven to be a useful procedure

CASE IV—The fourth case is one of *chondromyoma* or *benign cyst* occupying the upper half of the right thoracic cavity and arising presumably from the costovertebral articulations of the fourth and fifth ribs

The patient, a man, aged forty-seven years was admitted to the Johns Hopkins Hospital, November 13, 1920, complaining of pain in the right upper thorax and cough

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with bloody sputum. Six years before admission he began to have pain in his right upper thorax and under his right scapula. About the same time he developed a cough which was thought to be due to pleurisy. There followed attacks of fever, increased pain, cough and hoarseness which put him to bed three or four times a year for periods of three or four weeks. A year before admission he had during one of these attacks a profuse hemorrhage from his lungs and was seriously ill with a high fever and delirium. After convalescing from this attack he was sent to Saranac where he remained six months and where repeated sputum examinations failed to show any tubercle



FIG. 8. — (C. C. C. III) Anteroposterior view showing the shadow of a tumor to the right of the cardiac shadow.

bacilli. A needle was inserted into his chest and blood obtained. During the year before admission he had become increasingly more dyspnoeic and had lost weight.

Examination showed immobility of the right upper thorax, dulness on percussion extending down to the second rib in front and the fourth spine behind, and diminution in the breath sounds. X-ray plates of the chest (Fig. 9) showed a large mass occupying the upper half of the right thorax. A diagnosis of a benign new growth was made with the supposition that it was a dermoid cyst.

Operation was performed November 18, 1920. Under simple ether anaesthesia an incision was made anteriorly over the fourth rib from the right sternal margin to the anterior axillary line. The fibres of the pectoralis major were separated and about six

inches of the fourth rib resected. The parietal pleura was stripped from the thoracic wall over a fairly wide area. Beneath it the lung was seen moving freely, and on palpation through the thin layer of lung tissue there could be felt a large, firm mass. The parietal pleura was therefore incised and the thin film of lung tissue freed from the presenting surface of the tumor. The lung was but slightly adherent to the mass and could be readily freed from its surface. After about half the mass was freed it presented itself as a spherical tumor as large as a grapefruit, filling almost the entire upper one-third of the right thoracic cavity, definitely fluctuant on palpation and with a

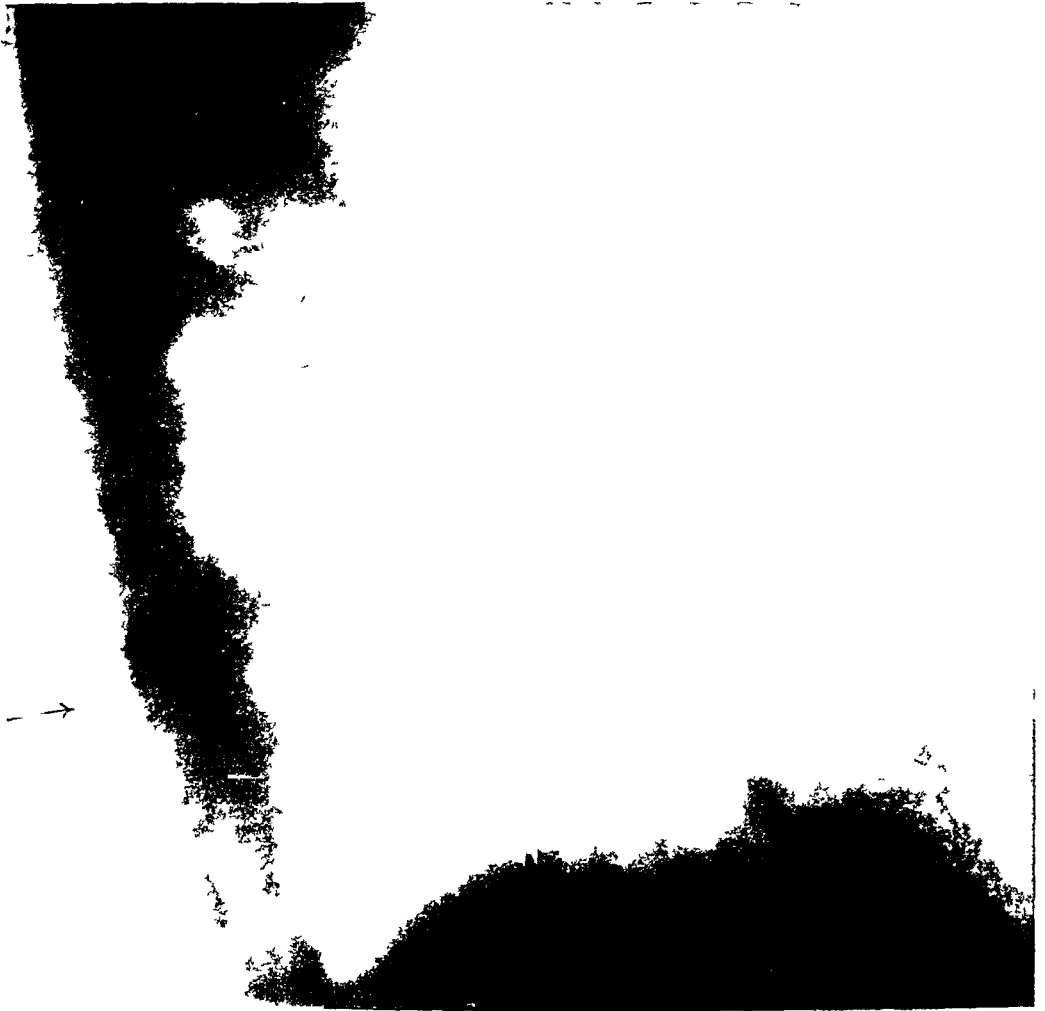


FIG 6—X-ray of Case III. Lateral view showing the shadow of the tumor against the spine

grayish-yellow wall in part calcified. On continuing the enucleation of the mass the lung was found to be adherent in one area, and here the wall of the mass was ruptured. There escaped a gelatinous myxomatous material, and thinking that the removal of this might help us in our further efforts, we deliberately incised the wall of the mass and removed large quantities of this sticky material. Inserting our hand within the mass we found the posterior half of it filled with aborescent masses of calcified tissue, which converged to a hard, bony mass fixed to the posterior thoracic wall. Returning at this point to the enucleation of the now collapsed wall of the tumor we freed it posteriorly to a point where it converged into the bony mass just described. This mass was most firmly united to what was taken to be the fourth and fifth ribs at their junction with the



Fig. 1

Fig. 1. Cut surface of the tumor (xanthoma) of the eye of a patient with xanthoma.

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vertebral column. It was freed from its attachment with rongeurs and the entire wall of the tumor removed.

There was practically no bleeding throughout the procedure and there was not at any time any respiratory disturbance or cyanosis. The wound was closed without drainage. The patient was considerably shocked at the end of the operation and his pulse was about 150. His color, however, was good and we felt no particular anxiety about his condition. Suddenly about an hour after operation he gave a few gasping respirations and died. An autopsy was not obtained.

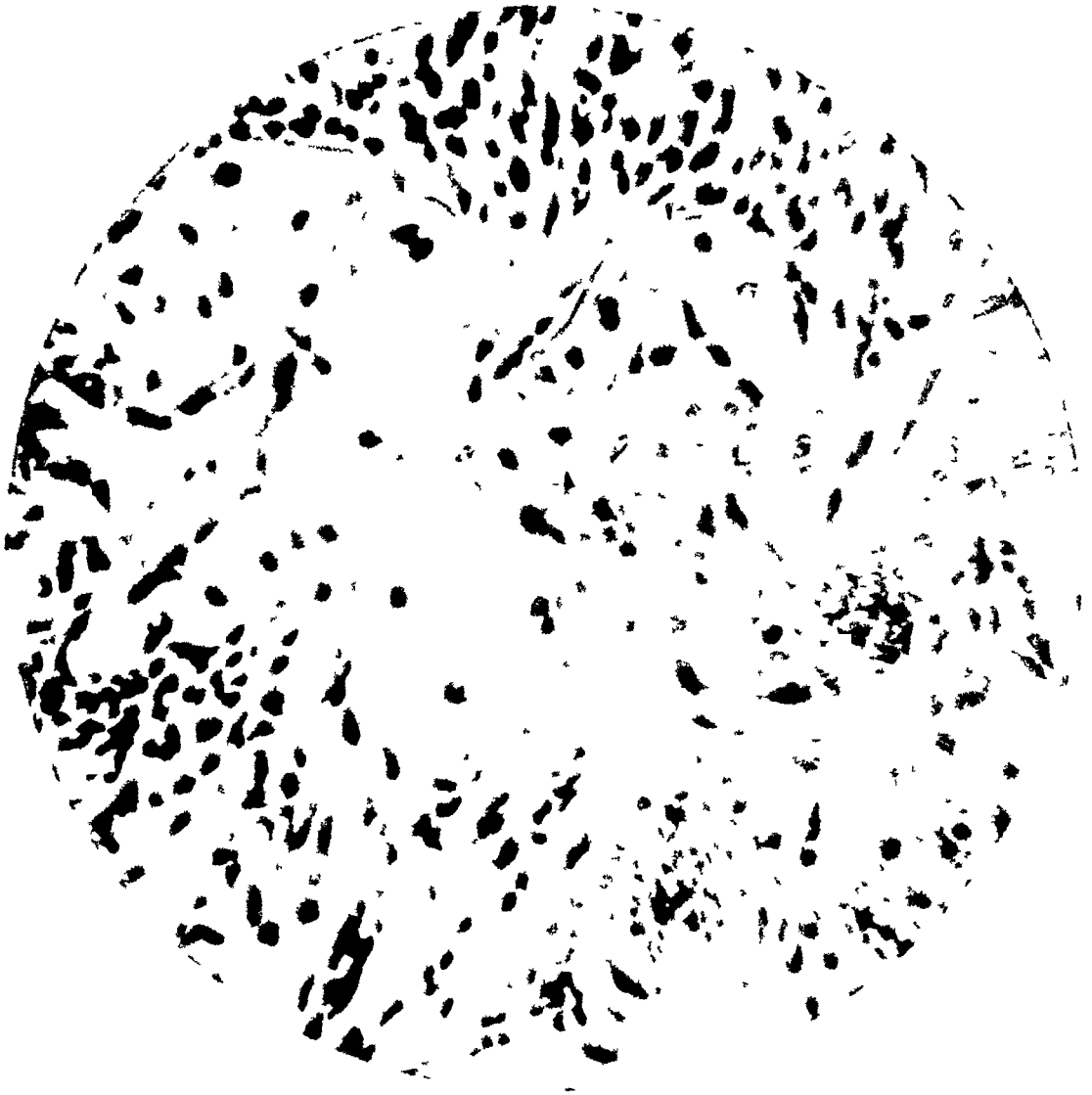


FIG. 5.—Cellular reaction of xanthoma to the group of "foam" cells.

Comments.—It was indeed hard to lose the patient after the removal of what was evidently a benign lesion. The nature of this tumor to my mind is in doubt. Bloodgood, examining various portions of its wall, concluded that it was a benign cyst resulting from a hemorrhage due to tuberculosis, with the organization of a hematoma and ossification of its wall. Against this diagnosis was the clinical appearance of the tumor at operation and the fact that it was entirely extrapulmonary and I believe extrapleural. No connection with the lung could be determined at operation nor the source of the previous

hæmoptysis The tumor had no connection with the mediastinum and therefore a dermoid can in all probability be ruled out Our own opinion, based largely upon the findings at operation, is that the mass was a myxochondroma arising from the posterior thoracic wall

CASE V—This is one of *pleural endothelioma*, possibly of *sarcoma*, arising in the upper right thorax

The patient, a man, aged thirty-three years, was admitted to the hospital, February



FIG 9—X-ray of Case IV showing a dense circumscribed shadow in the upper half of the right thoracic cavity

16 1920, complaining of pain in his right chest Five years previously he began to have thoracic pain localized at first in his right axilla, later becoming more general This had gradually become more severe Pain was the only symptom complained of until a year before admission, when he developed a cough which has persisted It was unaccompanied by sputum or hæmoptysis Recently there had been some dyspnoea even on the slightest exertion In the five years of his discomfort he had consulted numerous

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physicians had many X-rays taken all of which showed an intrathoracic tumor, and had tried a course of radium treatments in Baltimore without benefit.

Examination showed a well nourished man with moderate dyspnoea, with limitation of movement of the upper right thorax and with dullness over the upper right chest in front and behind. To the right of the sixth dorsal spine over an area 3 cm. in diameter could be heard a fairly loud systolic murmur which was not transmitted from the cardiac area. X-ray examination (Fig. 10) showed a large intrathoracic mass which did not pulsate on fluoroscopic examination and which was diagnosed a cyst or a sarcoma.



FIG. 10.—X-ray of C.C.V. showing a circumscribed shadow in upper half of the right thoracic cavity.

Operation was performed February 21, 1920, under simple ether anaesthesia. A T-shaped incision was made over the right thorax anteriorly, the horizontal leg extending from the sternal margin laterally to the axilla over and parallel with the third rib, the vertical leg paralleling the right sternal margin. The third rib was resected, the costal cartilages of the second and fourth ribs were divided at their junction with the sternum permitting wide retraction with a rib spreader. The parietal pleura was stripped from the thoracic wall, this procedure allowing a still greater field for exploration. No adhesions between the lung and parietal pleura were seen. The pleura was therefore freely incised at a point of election and an attempt made to free the presenting portion of the upper lobe of the lung from the underlying tumor. Unlike the preceding case, this was an extremely difficult matter, due to adhesions between lung and tumor and to numerous thin-walled vessels, bleeding from which was quite profuse. Finally, however, after considerable effort and some loss of blood, about half of the tumor was freed. It was the size of a grapefruit, deep red, succulent, pulsating, almost fluctuant, and evidently

very vascular. It was immovably fixed apparently to the mediastinal structures and the posterior wall of the thoracic cavity. A large aspirating needle was introduced into the tumor and pure blood, which, under the microscope, showed no abnormal cells, was withdrawn.

In view of the size, vascularity and fixation of the tumor any attempt to remove it was abandoned. The wound was carefully closed without drainage. The patient made a prompt recovery from the operation, but pain naturally continued. Thinking that a thoracic decompression might aid both pain and dyspnoea, the patient was again subjected to operation.



FIG. 11.—X-ray of Case VII showing tumor opposite the ninth and tenth thoracic vertebrae.

home, however, his pain and dyspnoea returned. A newspaper clipping received four months after operation stated that he had died.

Comments—The interesting features in this case are, first, the size and extraordinary vascularity of the tumor. As recorded in the history a bruit could be heard over it and at operation it definitely pulsated. The examination of the aspirated contents removed at the second operation showed large masses of tumor cells, the character of which suggested to Bloodgood an endothelioma or a sarcoma. MacCallum confirmed the diagnosis of endothelioma. A second feature was the satisfactory exposure of a large tumor by an anterior approach, first used, I believe, by Tuffier and Le Fort. By the resection of a single rib, combined with the division of the adjacent costal cartilages, an exposure was obtained which would have been adequate for the removal of this tumor. A third feature was the inadequacy of a decompression operation to relieve for any period the pain and dyspnoea. From the

On March 13, about three weeks after the first operation, a long incision was made across the back over the course of the eighth rib. The lower angle of the scapula was reflected upward. Portions of the sixth, seventh and eighth ribs were resected, totalling 46 cm. The intercostal muscles of the sixth and seventh interspaces were excised. Immediately under the operative field was the tumor, which was under such pressure that when the ribs were resected the mass actually bulged through the operative opening. The pleura was incised and an attempt again made to determine the origin of the tumor. We could merely say that the mass was firmly fixed to the posterior thoracic wall and to the mediastinum. The mass was again aspirated and the material sent to the laboratory. The wound was closed without drainage.

The patient again made an uneventful recovery. The wound healed *per primam*. He was discharged from the hospital three weeks after operation, with marked improvement in his pain and dyspnoea. Some time after returning

appearances at operation *i.e.* the pressure exerted by the tumor upon the thoracic wall and necessarily upon the mediastinum and the herniation of the mass through the operative defect as occurs in cranial surgery, I had anticipated that this was an ideal case for a decompressive thoracotomy. Such, however, was not the case.

CASE VI.—This is a second case diagnosed as a *pleural endothelioma*.

The patient, a white man, aged forty-five years, entered the Johns Hopkins Hospital, December 7, 1921, complaining of a painful lump in his right side. He dated his illness from an attack of influenza three years previous to his admission. During this illness he complained of soreness under the ribs of his right side, which continued and increased after the attack of influenza had subsided. In August, 1921, he first noticed a small, painful nodule upon one of his ribs which gradually increased in size until at the time of his admission it measured about 6 cm. in diameter. The pain, which at first was local, later extended to the pit of the stomach and around to the back. It had become so severe that the man was unable to work and could not sleep.

Examination showed a fairly well developed, although anemic man. Near the right costal margin inside the mamillary line was a non-pulsating, hard tumor mass measuring 6 x 5 x 3 cm. and apparently firmly attached to the seventh and eighth ribs. The skin over the tumor was freely movable. The X-ray of this region was quite negative. Examination otherwise showed old healed tuberculosis of both apices. A diagnosis of probable sarcoma of the rib was made.

Operation was performed December 14, 1921, by Dr. Emil Holman, then resident surgeon at the hospital. A long incision encircling the thorax was made parallel with the seventh and eighth ribs. The superficial muscles overlying the tumor were divided. The deeper muscles were attached to the growth and were subsequently removed with it. On close examination the mass appeared to penetrate the thoracic wall between the seventh and eighth ribs not to arise from them, and this observation was later confirmed. The seventh and eighth costal cartilages were divided at their junction with the sternum. An attempt was made to strip the parietal pleura but this was unsuccessful, and the pleural cavity was widely opened. There was a momentary respiratory upset and anesthesia was continued with a gas-oxygen apparatus using positive pressure. On opening the pleural cavity the greater part of the tumor was found to be intrathoracic. It involved both leaves of the pleura in the costophrenic sulcus and was firmly adherent to the diaphragm. The bloc removal of the tumor required the wide resection of the seventh and eighth ribs, the resection of a fairly large area of the diaphragm and of the diaphragmatic and costal pleura. The diaphragmatic reflection of the peritoneum was exposed but not opened. The closure of the defect in the diaphragm was difficult, and as a result of the resection of this structure it could not be used in the plastic closure of the large opening in the thoracic wall, as in a previous case. Closure of the thoracic opening, however, was accomplished by use of the external oblique muscle, the rectus sheath and the anterior portion of the latissimus dorsi muscle.

Post-operative convalescence was uneventful excepting for a mild respiratory infection. The wound healed *per primam*. The patient was discharged from the hospital three weeks after operation, quite relieved of his pain and in excellent physical condition. A letter from his family states that he died ten months after operation.

The tumor on removal was about the size of a lemon. The pleura over it was attached and thickened. From the gross examination it could not definitely be said, in my opinion, that it arose from the pleura. Yet if it did not its origin is as problematical as is that of the sarcoma previously recorded. The microscopic diagnosis made in Bloodgood's laboratory was endothelioma of the pleura.

Comment. The only unusual feature of this case from an operative stand-

point was the necessity of resecting the diaphragm. The closure of the defect proved to be unexpectedly difficult. Whether closure upon the right side is necessary is a question upon which we have very little information. Upon the left side, however, one would be unwise, I think, to leave a defect of any size even with an intact peritoneum.

CASE VII—This is a third case diagnosed as *pleural endothelioma*.

The patient, a white girl, aged seventeen years, was admitted to the Johns Hopkins Hospital, October 21, 1921, complaining of a swelling upon her back. About eight

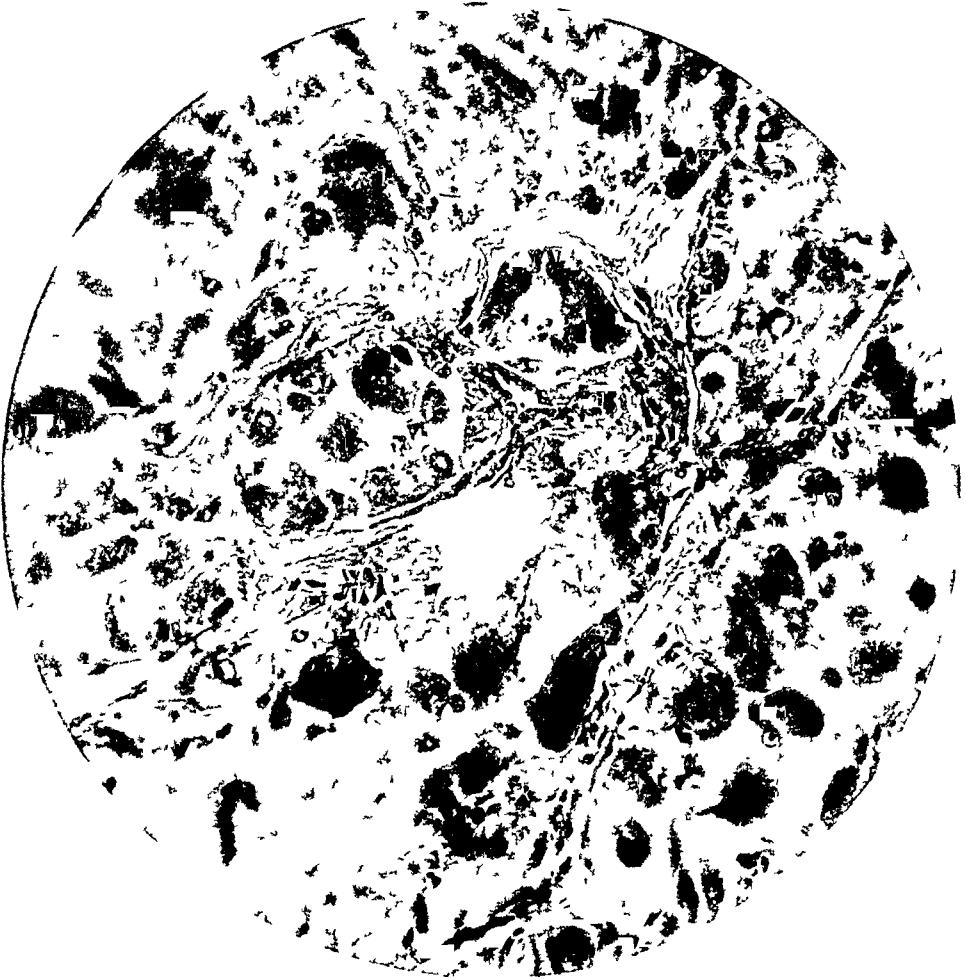


FIG. 12.—Microscopic section of the tumor removed from Case VII.

months before admission she noticed a small, painless lump just below the angle of the left scapula. Her family physician said it was a cyst and at first little attention was paid to it. The mass, however, increased rather rapidly in size and five months after its appearance became painful, the pain radiating up to the left side of the neck and around the left side. In the two months before her admission this pain had become so severe as to quite incapacitate her.

Examination showed a fairly well-nourished and well-developed girl in whom the only abnormality found, with the exception of the tumor to be described, was a well-compensated mitral insufficiency. Just below the inferior angle of the left scapula

was a swelling as large as a hen's egg the skin over which was normal in appearance and freely movable. On palpation the mass was tense, gave the impression of fluctuation and pulsated with a definitely expansile pulsation. Over it could be heard a loud systolic bruit. It seemed to be attached to the ninth and tenth ribs. X-ray (Fig 11) showed a tumor mass and a partial destruction of the ninth and tenth ribs close to the spine. Bacteriogram from the X-ray plate alone suggested an acute infectious process. Fletcher made a diagnosis of aneurysm of the descending thoracic aorta and Baer thought it was a cold abscess with transmitted pulsation. A younger member of the surgical staff aspirated the swelling and obtained what appeared to be pure blood but which when examined by Guthrie showed masses of tumor cells. A final diagnosis of intrathoracic tumor either endothelioma or sarcoma was made.

Operation was performed October 26, 1921, under simple ether anesthesia. A large skin flap with its pedicle over the spine was reflected. The erector spinae muscles over the mass were displaced mesally and laterally, a procedure which exposed the tumor still covered however with muscle tissue. The ninth and tenth ribs were exposed and divided well in front of the tumor and an attempt made to strip the parietal pleura. On approaching the mass the pleura was found adherent to it, therefore the pleura was freely opened and the tumor examined. It was the size of a lemon, was rather fixed to the ribs and vertebrae and had no connection with the aorta. The pleura over it was thickened and presented plaques and masses of tumor on its inner surface. The operation then resolved itself into the removal en bloc of the ninth and tenth ribs back to the spine, the tumor and the pleura. The removal of this bloc of tissue left a very large defect in the thoracic wall which however could readily be air-tightly closed by a muscle plastic. The wound was closed without drainage. At no time was there any respiratory upset.

Post-operative convalescence in this case was complicated by the development of a hemolytic streptococcus empyema. At the time there was in the hospital ward with the patient a considerable number of patients with influenza, and the patient herself developed a respiratory infection. Whether then the infection was introduced from without or from within is problematical. As soon as the diagnosis was made aspiration drainage at a point below the operative wound was instituted and dakinization of the cavity begun. Fortunately in spite of the intrapleural infection the large operative wound healed *per primam*. She was discharged two and a half months after operation with her empyema completely cured. A letter dated August 30, 1923, two years after operation, states that she is in good health but has some pain in her side.

Comments. An interesting feature in this case was the establishment of a positive diagnosis by the aspiration before operation of tumor cells. The method of diagnosis was, in Baltimore at least first largely used by Dr. C. G. Guthrie, and has proven very helpful in doubtful cases. The post-operative empyema which developed was most unfortunate, but happily did not interfere with a satisfactory result. It serves to illustrate what we so thoroughly learned in war wounds, *i. e.*, that in case of a pleural infection following an intrathoracic operation it is unwise to drain through the operative wound, for to do so means in most instances an infection of the wound with the development of an open pneumothorax. A microscopic section of the tumor is shown in Fig. 12.

CASE VIII.—This is a case diagnosed by many before operation as a mediastinal tumor which subsequently proved to be a *retropleural aneurysm of the descending thoracic aorta*.

The patient, a young man, aged twenty-nine years, was admitted to the Cincinnati

General Hospital, April 18, 1923, complaining of pain in his chest. He had been thoroughly studied in Baltimore and through the kindness of medical friends there had been sent to Cincinnati for observation and treatment. The history relates that while with the army in France, early in 1919, he began to have pain in the back which at first was localized under the right scapula. The pain came on spontaneously without known cause. It gradually increased in severity, radiated around to the front of the chest and was associated with hyperæsthesia of the skin about the right costal margin. Since its onset the pain has never disappeared and has gradually worn down the patient's resistance,



FIG 13 —X-ray of Case VIII showing the large centrally placed shadow in the thorax

so that recently he has been quite incapacitated. There has been some dyspnoea on exertion. He has never had cough or expectoration. Since 1919 he has been, with the exception of short intervals, an inmate of hospitals in France and this country. He has repeatedly been examined, numerous X-rays and fluoroscopic examinations have been made and his Wassermann reaction has been repeatedly tested. All examinations have shown an area of dulness over the back, extending from the fifth to the ninth dorsal spines and 13 cm to the right and 4 cm to the left of the posterior median line. All X-rays have shown a large mass in the posterior mediastinum extending to either side of the midline. No observer has, so far as I can gather, seen this mass pulsate on fluoroscopic examination. One roentgenologist at Fort McHenry, Baltimore, suggested the diagnosis of aneurism, all other observers had made a diagnosis of mediastinal tumor. One Wassermann reaction was weakly positive, many others were negative. He has received an excessive amount of antiluetic treatment without avail, nor have deep X-ray therapy or radium treatments had any influence upon his symptoms.

Our own examination seemed to confirm those previously made. The same area of dullness over the back was found and stereoscopic X-ray plates (Figs 13 and 14) showed a large mass rather centrally placed in the posterior mediastinum. Examined fluoroscopically the mass lay behind the base of the heart and did not pulsate. The ascending arch of the aorta could be seen displaced upward and to the right, and could be clearly differentiated from the mass by its pulsation. On swallowing bismuth the esophagus could be seen curving forward in front of the mass. In view of our previous experiences we also made a diagnosis of tumor probably extrapleural and arising from the ribs or spine.

Operation was performed May 10, 1923, with intratracheal insufflation anesthesia. A long lateral incision was made over the right fourth rib extending from the posterior axillary line to the sternum. The fourth and fifth ribs were resected. Beginning posteriorly the parietal pleura was widely mobilized until the right lateral border of the mass was exposed. The mass was definitely extrapleural for the parietal pleura could be freed from its anterior wall. For the pleura was reflected and therefore was incised and the pleural cavity widely opened. The mass was of large size and lay behind the base of the heart, the descending arch of the aorta and the esophagus.

It was unconnected with any structures in front but posteriorly was firmly fixed to the posterior thoracic wall and spine. Its present surface was smooth and grayish yellow in color, not unlike the case of chordoma previously described. The mass as a whole pulsated strongly. Fearing that after all the lesion was an aneurism, a con-



FIG. 1.—X-ray of Chest VIII lateral view showing outline of tumor behind the cardiac arch.

siderable amount of time was expended in discovering the possible origin of the mass and as a result of our efforts we concluded that the mass fused with or blended with the descending aorta behind the base of the heart. My assistants, however, were not satisfied and therefore we deliberately incised the mass, extruded some clots for examination and resutured the incision. There was no hemorrhage during the procedure. The examination of the clots failed to show anything but blood cells.

Not being prepared by our exposure to treat the aneurism at its source the operation was abandoned. The pleura was resutured and the wound closed without drainage. The post-operative convalescence was complicated by the formation of a bloody effusion which, however, disappeared after one aspiration. The wound healed *per primam*. For twelve days the patient remained in excellent condition then suddenly after great pain he became pallid and there appeared a pulsating mass under his operative scar. He died May 19th.

Autopsy.—Retropleural aneurism of the descending thoracic aorta. Rupture of the aneurism along its right lateral border. Massive right hemothorax. The communication between the aorta and the aneurismal sac was in the posterior wall of the aorta directly in the midline and measured 3 cm. in diameter. The sac extended retropleurally

to either side of the spine, but farther to the right than to the left. Its posterior wall was formed by the vertebrae which were markedly eroded and by the adjacent posterior thoracic wall. The incision made at operation into the anterior wall of the sac had healed. Rupture of the sac had occurred about 4 cm from it at the junction of the anterior wall of the sac with the posterior thoracic wall.

Comments—The case is included in this series because it demonstrates the difficulties in the differential diagnosis between some thoracic aneurisms and intrathoracic tumors. Two other cases in this series—both with expansile pulsation—were diagnosed wrongly as aneurisms. This case pronounced by many competent observers a solid tumor proved to be an aneurism. It is well known, of course, that aneurism of the thoracic aorta may not show visible pulsation under the fluoroscope. But in this case the age of the patient, the duration of the symptoms and especially the position of the mass were all against the diagnosis of aneurism.

Summary—Of the 8 cases in this series 6 recovered from operation, 2 died soon after operation. 1 with symptoms of pulmonary embolism and 1 from the rupture of an aneurism. Of the 6 patients who recovered, 2 are living and well five or more years after operation and 2 are living and apparently well two years after operation. One patient died four months after operation unimproved by a decompressive thoracotomy, and 1 patient died ten months after operation from a recurrence of his disease. The lesions form a miscellaneous group and the diagnosis in a number of cases remains in doubt. The nature of one, a calcified intrathoracic cyst, remains problematic, as does the large tumor called by Bloodgood a hemorrhagic cyst, by me, a chondromyxoma. The sarcoma of the ribs, the xanthoma and the aneurism are sufficiently well established, but I am not so clear regarding the 3 instances of circumscribed encapsulated tumors called by our pathologists endotheliomata of the pleura. These tumors were first described by E. Wagner, later by Schulz, as extensive diffuse tumor formations giving rise to a markedly thickened pleura and associated with a bloody effusion. I have seen 2 such cases. 1 in Baltimore and 1 in Cincinnati. In both a thoracostomy had been done in the hope that drainage of the bloody effusion would relieve the pain and dyspnea. In one the X-ray showed the entire pleura about three inches in thickness and in the other it showed a solid shadow due to the almost complete filling of the entire half of the thorax with tumor tissue. In none of the works on pathology which I have been able to consult do I find described the circumscribed encapsulated endotheliomata of the pleura such as we have had. Aschoff, however, in his classification of endotheliomata into hemangio-endothelioma, lymphangioendotheliomata and perithelioma states that the lymphangioendotheliomata may occur as circumscribed tumors, and it is possible that such tumors of the pleura may be analogous to those of the dura and pia-arachnoid.

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TUMORS OF THE MEDIASTINUM IN CHILDREN

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THE two following cases, occurring within a few days of one another, in the surgical service of the Children's Hospital, Boston, seem to be of sufficient interest because of their relative infrequency and obscure etiology to justify reporting them

CASE I—Dorothy T, aged four and one-half years, admitted April 2, 1921

Family History—Father, mother and one sister are living and well. Mother had no miscarriages. There is no history of tuberculosis, carcinoma or insanity in the family. Both parents seem below normal mentally.

Past History—Child was a full-term baby, normally delivered. Birth weight is not known. She was breast-fed for one year and did well. Since then she has been on a mixed diet. She has been below normal for the past two years, and was diagnosed as a case of malnutrition. She had four or five fainting spells last year. She has had no contagious diseases. On February 20, 1921, she had an acute illness with pain in the left chest and shoulder, some fever, and rapid and labored respirations. This subsided after ten days, but she never fully recovered. It was thought to have been pneumonia by family physician.

Present Illness—The present illness dates from the acute illness in February. Dyspnoea has persisted since that time, with malaise, debility and malnutrition. On March 29 prominence of the left chest was noted in the region of the nipple for the first time. This increased steadily. There was no pain or cough. Loss of appetite, constipation, dyspnoea and malnutrition were present. Patient seemed drowsy.

Physical Examination—The patient is a poorly developed and nourished child of four and a half years, of average mentality. The skin is dry, pale and scaly. The head is negative.

Eyes—The right shows internal strabismus, and the pupil is larger than the left. Both pupils react to light and distance. The nose is negative. The mucous membranes of the mouth are normal. The teeth are in poor condition. No Koplik spots are seen. The right tonsil is enlarged and ragged. The neck shows no rigidity or retraction.

Thorax—The left chest bulges prominently anteriorly, extending well towards the axilla. There is no obliteration of the intercostal spaces. The respiratory movements are restricted over the entire left chest. (See Fig 1.)

Lungs—The right side is hyper-resonant except where the heart impinges. Breath sounds on the right are positive. There are crackling rales in the right infraclavicular spaces. The left side is flat anteriorly to percussion in the axilla, dull in the back. Breath sounds are absent in front except at the apex and just below the clavicle, and are very distant in the back. Traube's space is dull.

Heart—The impulse is felt on the right side in the fourth, fifth and sixth spaces. The right border of the heart is 10.5 cm. to the right of the mid-sternal line. The left

border is not determined The sounds are regular and of good quality, there are no murmurs

Abdomen—The liver is 8 cm below the costal margin The spleen is not felt

Extremities—Normal Reflexes Normal knee jerks No Babinski, or Kernig, etc No ankle clonus Glands The right sub-mandibular glands are enlarged Spine Negative Genitalia Normal

Diagnosis—Question of empyema

Hospital Notes Blood Rcd blood-cells—Five million, six hundred and eighty-six



FIG 1—Case I Lateral view illustrating asymmetry of chest pre operative

thousand per cubic millimetre Hemoglobin Eighty per cent by Tallquist White blood-cells Thirteen thousand per cubic millimetre

Ton Puquet—Negative after sixty hours

X-ray Examination of Chest—There is a definite shadow over the entire left chest except about the region of the heart apex The right side also shows a shadow with ill-defined borders about the hilus The shadow on the left side is very definitely mottled with areas suggesting bone Chest tap 7th left interspace, 100 cc of thin

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yellow fluid obtained with numerous small fibrin clots Cell count 5000 per cm Differential count, 71 per cent , polymorphonuclears, 29 per cent , mononuclears, few small (?) diplococci, without capsules are seen No tubercle bacilli are noted A few endothelial cells are present

Urine—Amber, cloudy, acid, 1032, no sugar, no albumin, sediment 5 mm , amorphous urates, no white blood-cells, reds or casts are seen

April 4, 1921—Chest cultures are sterile after forty-eight hours

April 5, 1921—Chest tap, 240 c c dark, brownish-red muco-purulent fluid

April 6, 1921—White blood count 17,600

April 7, 1921—Chest tap, 180 c c clear stringy fluid Many white blood-cells, polymorphonuclears 96 per cent , lymphocytes 4 per cent

April 8, 1921—Fluoroscopy shows right side of diaphragm moves fairly, but left practically fixed General condition of child shows no change, no pain, breath sounds come through slightly better following tap

April 8, 1921—Chest fluids all reported as sterile by Harvard Medical School Bacteriological Laboratory

April 8, 1921—Pathological laboratory reports fluid contains epithelial cells and a few fine hairs

April 9, 1921—Transferred to surgical service with diagnosis of dermoid cyst of the mediastinum

April 12, 1921—*Operation*—Ether anæsthesia Excision of tumor Child lying semi-recumbent on the right side, the left arm drawn upward and forward Incision made over the 7th rib from the mid-axillary line forward to the junction of the ribs and cartilages Periosteum reflected and four inches of rib excised The posterior layer of periosteum and pleura incised, found to come down onto tumor, which was not especially adherent anteriorly Finger inserted, could sweep around tumor, breaking up delicate adhesions, edge of tumor found to be fairly well encapsulated Incision then carried upward through costal cartilages to the third rib The flap of chest wall thus formed turned upward and hand inserted into chest sweeping around tumor This was found to be rather densely adherent posteriorly and toward pericardium elsewhere it was fairly free It extended across the midline, reaching to the right of the bodies of the vertebræ to a slight extent An attempt was made to evacuate some of the cystic contents of the tumor, but the cysts were too small and the tumor too solid to diminish its size With great force the tumor was then dragged out of the chest and pericardial adhesions freed Chest cavity was at once packed with gauze and swathe applied Child put to bed in sitting position Tumor measured 15 x 11 x 9 cm , irregularly lobulated

There was comparatively little hemorrhage Shock very great Child rallied well and in a short time was crying

April 13, 1921—Severe reaction, temperature elevated, pulse weak Constant stimulation with camphor and caffeine given

April 15, 1921—Packing removed, practically no oozing Temperature still high (102.5°), but pulse is better

April 18, 1921—Child definitely better, eating well Chest cavity shows some tendency to "fill in" Secondary infection present Daily dressings with rubber dam and adhesive to make valve out of chest flap

April 27, 1921—Marked improvement—appetite good chest cavity reducing in size Recovery now seems only a matter of time

June 23, 1921—Steady improvement, condition excellent, eats well, plays much of time, chest wound nearly healed, lung expansion nearly complete by X-ray Negligible drainage No cough Is to be discharged to Wellesley Convalescent Home for a few weeks before going home Re-admitted August 16, 1921, from Wellesley Convalescent Home Has not done as satisfactorily as expected at Wellesley for the last three

weeks The old skin incision is still open and draining pus rather freely The edges of the wound show unhealthy granulations Little or no expansion of left chest—resonance much diminished—distant bronchial breathing along posterior spine No breath sounds heard in axilla Diagnosis Post-operative empyema

August 20, 1921 —Not satisfactory, losing ground, no appetite, anæmic and apathetic Temperature remains elevated, 102°

September 1, 1921 —Temperature normal for first time, but general condition worse

September 8, 1921 —Condition very poor, wound gaping, foul, discharging pyocya-



FIG. 2—Case I Radiogram of chest following aspiration showing size of tumor in relation to size of chest

neous pus Question of secondary KL infection raised Three thousand units of antitoxin given intramuscularly Heart action poor Urine filled with pus, blood and casts Question of secondary nephritis

September 12, 1921—This morning child appeared much worse Pulse very poor No result obtained from stimulation While preparations were being made to take down the dressing the patient suddenly stopped breathing and all efforts to stimulate it proved ineffectual Post-mortem examination not obtained No evidence clinically of metastases

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Pathological Report—The specimen consists of an irregularly lobulated, ovoid-shaped tumor, measuring in its greatest dimensions 15 x 11 x 9 cm. Its weight, after the escape of between 50 and 100 c.c. of blood-tinged myxomatous fluid from a ruptured cyst is 865 grams. The tumor consists of a large central mass with a slight constriction on its mesial aspect, suggesting an attempt at lobulation. There is no definite pedicle to the tumor. Mesially, however, overlying the constricted area just noted, are two thin layers of tissue lined with smooth glistening epithelium which formed the wall of the ruptured cyst and which were apparently attached by their lateral surfaces to the pleura or pericardium. Lining this cyst there is one definite papillary projection of epidermis, from which a tuft of fine hair about 1.5 to 2.0 cm. in length protrudes. The interior of the cyst is filled with a cheesy, fatty detritus which is still mixed with the somewhat slimy myxomatous fluid already noted. (See Fig. 3.)

Three or four smaller lobulated projections stud the main mass of the tumor, each presenting a somewhat rounded elevation varying from 1.0 to 2.5 cm. above the surface. These are of the same general appearance and consistency as the main tumor and on section show no particular differences warranting any separate description.

The whole tumor mass is surrounded by a dense capsule of connective tissue which is grayish in color, except where trauma and hemorrhage have caused a deposition of blood pigments into or under the protective layers of this capsule. The capsule, however, does vary considerably in its character and thickness. There are definite areas containing irregular plaques which have undergone calcification. These are indistinguishable from actual bone, and indeed one or two of these areas resemble very strikingly abortive attempts at true bone formation, with results not unlike slightly malformed ramus of the hyoid. These plaques are found buried in the substance of the capsule, some scarcely palpable in the gross, others quite definite and of considerable size.

The blood supply of the tumor is apparently derived from capillary vessels entering the capsule, as no pedicle or hilus vessels are seen. (See Fig. 4.)

On cross-section the tumor is found to consist of a coarse framework of connective tissue, bone and cartilage, in which are embedded innumerable cysts varying greatly in size and character. It is relatively avascular, no vessels of noteworthy size being cut through. The cut surface presents a rather dirty, grayish-yellow appearance, which on analysis is seen to be due chiefly to the presence of a great deal of fatty debris in the cystic areas, and the presence of a black pigment similar in the gross to that seen in the choroid, which outlines a certain proportion of the cysts. There is likewise the presence of trabeculae of blue-gray cartilage and bone which heightens this avascular, grayish color.

The most striking feature of the cut surface is the polycystic character of the tumor. These cysts vary in size from those scarcely discernible with the naked eye to those measuring 2 cm. in size, besides the larger one noted earlier. The average size is 2 to 5 mm. in diameter. These cysts are sometimes empty, sometimes filled with a honey-like, cloudy fluid, sometimes with mucoid, pale, translucent "jellied" material, sometimes with a fine yellowish, granular debris suggestive of cholesterol, often with a more frankly sebaceous material. Others present a mixed content. Certain cysts are multilocular—for the most part, however, they are monolocular.

Their surfaces are as varied as their contents. Certain of them are apparently lined with normal epidermis, some containing fine light brown hair, coiled up within the cyst and growing in tufts from papillary projections of the skin. Others are lined with a smooth epithelium resembling mucous membrane, others with chromatophoric tissue, identical in appearance with the choroid of the eye. Still others present papillary projections of mucous membrane suggestive of intestinal folds. The appearances are too manifold to be differentiated except under the microscope.

In the stroma there is likewise very little satisfaction in a gross description. There is a generous stroma made up apparently of connective tissue which has undergone differ-

entiation into various of its derivatives, notably cartilage and bone and in the substance of which are embedded these multitudinous cysts and islands of other tissue, suggestive of ecto and mesodermal origin

Microscopical Examination *—Microscopically the sections confirm the gross diagnosis of mediastinal teratoma. All three fetal germ layers are present, and there are obvious abortive attempts to form organs or parts of organs. There is no order about the arrangement of the tissues, neuroglia and striated muscle, epithelium and bone, side by side with no thought of function. Possibly the best way to study the sections is to take up the various derivatives of the entoderm, mesoderm and ectoderm. Almost any section studied will reveal on careful search nearly the entire variety of tissues described below.

Entoderm—The entoderm is represented by various types of epithelium, which, while less prominent in amount, are no less important in establishing the final diagnosis.

(1) Mucous membrane with typical "goblet" cells occurring in single layers of columnar cells, or at times in a semi or completely stratified manner are noted frequently as lining many of the cystic areas. Certain of these latter are quite indistinguishable from the less characteristic single epidermis-lined cysts.

(2) Typical gastro-intestinal mucosa with the formation of rugæ of varying height is another feature which is one of the most striking microscopic pictures presented. In one area, as noted under mesoderm (5), there is a definite attempt to form a small portion of intestine which histologically most closely resembles duodenum. There is a definite lumen, a very characteristic mucosa, and loose connective-tissue submucosa, and two thick layers of smooth muscle, the inner arranged in circular fashion, the outer in longitudinal.

(3) Ciliated epithelium arranged usually in a pseudo-stratified layer, as in the trachea and œsophagus, is seen lining certain of the cysts. Occasional goblet cells are seen in their midst and the cysts are filled with a cellular, mucoid debris.

(4) Epithelium suggesting alveolar arrangement as seen in the lung is noted in a few places lining some of the cysts.

Mesoderm—(1) Connective tissue in all forms is seen everywhere throughout the tumor, from the youngest undifferentiated, mesenchymal, spindle-like cell to the adult, elongated nucleus with its coarse fibroglia fibres and its dense collagen fibres. In places there are small areas where it has produced typical myxomatous tissue, in places the collagen fibres are nearly as densely packed as in a keloid. Again, elastic tissue fibres can be differentiated in places. In the adult form the fibroglia fibres similarly vary from fine to coarse, from short to long.

(2) Cartilage. The cartilage occurs chiefly in the embryonal hyaline form as trabecule or plates undergoing typical changes peripherally, with differentiation of the connective tissue, the formation of a hyaline matrix and the characteristic lacunar arrangement of the nuclei.

(3) Bone. The bone is about equal in amount with the cartilage, and similarly distributed generally throughout the stroma. It occurs apparently in both forms, primary periosteal bone with osteoblast and osteoclast activity and secondary enchondral bone which is the result of secondary bone replacement of the cartilage. There are also seen three or four small foci of so-called "osteoid" tissue where the arrangement of the tissue is similar to that seen in typical periosteal bone, but where calcification has not occurred.

(4) Blood-vessels. These are not a prominent feature, occurring chiefly as small capillary vessels. A few larger arteries with well-developed walls containing elastic fibres and smooth muscle, are seen scattered here and there.

*Tissues fixed in formalin. Zenker's and Kaiserling (gross specimen). Imbedded in paraffine. Differentially stained by the eosin, methylene-blue, hematoxylin, eosin, phosphotungstic acid, hæmatestin, Mallory's connective tissue aniline blue, van Gieson's picric acid fuchsin, and Weigert's elastic tissue methods.

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(5) Smooth muscle occurs in varying amounts, usually in the form of bundles scattered throughout the stroma, next to neuroglia or epithelial cysts, with no regard to function. In several instances, one, particularly noteworthy, in relation to entodermal gastro-intestinal tract derivatives, it is seen arranged in characteristic fashion in two or three alternately arranged layers of fibres, creating an unmistakable attempt at forming a functional bit of intestine. It is also seen in the vessel walls around certain



FIG 3—Case I Mediastinal teratoma gross specimen (approximately three-quarter of actual size)
Note tuft of hair on posterior wall of exposed cyst

of the cartilaginous tissue much as seen in the bronchi, as well as scattered diffusely through the tissue

(6) Striated (voluntary) muscle. This is a less prominent feature of the tumor, and is only found in certain of the sections. It occurs as single cells, and in bundles. The appearance of the individual cells is very much that noted in a typical microscopic slide of a case of "amyotonia congenita." The cells vary in size from short cells whose cytoplasm scarcely more than extends beyond the nucleus and contains but two or three striæ to great long cells as large and coarse as those of the gluteal muscles. Then there are all gradations between these—long thin, incompletely striated cells, short,

thick, multistriated cells, cells which taper off to but one or two coarse fibrils, the termination apparently of the longitudinal striations, and other nondescript atypical cells with striæ which are incomplete

This striated muscle occurs chiefly in a few small foci as if some embryonal myomere had been displaced and there were an attempt for it to develop normally. Again there is a group of fibres arranged more or less around the wall of a cyst lined with a pseudo-stratified ciliated epithelium

Ectoderm—(1) There are innumerable cysts of every possible size and shape, lined by as many types of epithelium. Possibly the most common, and on the average the largest, are lined by a stratified epithelium which microscopically presents the characteristic picture of typical epidermis with a deep stratified layer arising from a normal appearing generative zone of "prickle cells"—large cuboidal cells with intercellular bridges. There is the normal papillary downgrowth of the epithelium into the corium which varies markedly in its appearance. In places the differences between the atypical epithelium of ectodermal origin and the stratified mucous membrane of entodermal etiology is most uncertain

(2) In addition, many of these cysts are complicated by having hair follicles and sebaceous cysts penetrating the underlying corium. These present normal histological characteristics

(3) Other cysts lined by stratified epithelium contain definite coil glands in their picture. A few even present the mixed arrangement of sebaceous and sudoriferous glands, as well as hair follicles

(4) Many of the larger cysts show marked desquamation of the horny layer of the epithelium into their lumina. This cornification may become so marked that even in the relatively deeper stratified layer there may be seen not infrequently the "epithelial pearls" so characteristically noted in epidermoid carcinoma

(5) Again, there are many cysts lined by a single layered epithelium. These are apt to be rather smaller. Many of them are difficult to differentiate from the entodermal epithelium as it varies from high columnar to low cuboidal. The chief differential point probably is the absence of mucous "goblet" cells

(6) One of the most striking things in the gross, which is corroborated by microscopic study, are the many cysts which are either partially or completely lined by a pigmented semi-stratified epithelium which appears in detail to be identical with that of the pigment layer of the optic cup. This impression is furthered by the contents of most of the cysts which are translucent and jelly-like—suggestively reminiscent of vitreous humour. These pigmented cells are seen occasionally in groups, possibly a portion of an adjoining cyst wall—but apparently lying independently in the stroma

(7) Neuroglia is very generously distributed throughout the sections, usually in bundles of relatively coarse fibres, some consisting of but a few cells with their fibrils, others of great masses of tissue 1 mm or more in diameter, lying with utter disregard or in junction close to bone or epithelial cysts or intestinal mucosa

(8) Nervous tissue. A few islands of rather characteristic brain-like tissue are noted with fine fibrillar material in which nerve cells with their dendritic processes are visible. Nothing which suggests cerebellar architecture however is noted

(9) Nerves. Only a single cross-section of a medullated nerve trunk is noted in the sections studied. This has a characteristic sheath and runs in a mass of rather loose connective tissue

(10) Ganglion cells. Several nests of ganglion cells are noted scattered very sparsely through the sections. These vary in number from three up to twenty-five or more. With the stains employed the Nissel granules are not well brought out, but can be seen to be present. Two of these groups of cells are in association with a mass of neuroglia fibres

(11) Glands. Epithelial glands whose structure is identical with coil or milk

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ducts are found frequently. When in association with epithelium of the skin type with hair follicles and sebaceous glands there is no difficulty in determining to which category they belong. Many of these glands with their inner lining layer of cuboidal epithelium and an outer layer of smooth muscle fibres occur free in the stroma, however, and there is no definite means of identification.

In conclusion then we may say that both the gross and microscopic examination of the tumor confirm in all respects the diagnosis of teratoma of the mediastinum. Derivatives of all three fetal germ layers are present in imposing array thus differing



FIG. 4—Case I. Cross section of tumor showing its multicystic character.

from the simple dermoid cysts which are composed only of epithelial derivatives with a connective-tissue stroma. In this tumor the organology is not as striking as reported in a few cases—no liver or pancreas tissue, no thyroid, no genito-urinary derivatives, no lymphoid tissues are noted. There is no attempt to form any extremities or head, but the whole is a confused picture of fetal cells growing wildly, irrespective of function. The impression of the tumor is one of a reticular stroma of connective tissue, bone and cartilage, in which can be found innumerable cysts of varying size and shape, lined by as many types of epithelium, and in the interstices of the stroma odd bits of fetal cell differentiation such as neuroglia, striated muscle and pigmented epithelium.

Diagnosis—Mediastinal teratoma.

CASE II—John H., aged twenty months, admitted April 5, 1921.

Family History—The father and mother are living and well. There are no other children in the family and no miscarriages.

Past History—The child was a full-term baby, with instrumental delivery. He was breast-fed for one year. He had chicken-pox at that time. There has been no other sickness until the present illness.

Present Illness—The patient had pneumonia three months ago. His temperature was high for two weeks, when the crisis came. He has been "ailing" since with a slight temperature and loss of weight. The chest was tapped by the family physician twice and 21 ounces of fluid obtained.

Physical Examination—Is essentially negative except for the chest. The child is moderately anæmic in appearance. On the left, expiration is diminished and the inter-

costal spaces full, broadened, and bulging during expansion. The whole chest is flat on percussion. The breath sounds are very faint. Tactile fremitus is diminished. Grocco's triangle is present at the right base. The heart is pushed over to the right. The liver is pushed down with bulging of the chest outward and upward.

Hospital Notes—Laboratory findings. Aspiration, red, thin, stringy fluid. No organisms are seen. Some cells are present. X-ray. A dense shadow in left lung area is noted, which thins out at the periphery. Temperature ranges from 98° to 101°. Blood. White blood count 19,600 per cu mm. Von Pirquet. Negative after sixty hours. Wassermann. Negative.

April 7, 1921—Child's condition is becoming worse rapidly. Tuberculosis has been ruled out fairly well. Another chest tap gives similar viscid fluid. The probability of malignant disease seems most likely diagnosis. From the operative point of view the case is hopeless.

April 8, 1921—Another chest tap gives 23 ounces of similar fluid. X-ray plates immediately after aspiration show a series of shadows in left side of chest as if cast by some markedly lobulated tumor. Patient became very much worse and died in the late afternoon.

Autopsy—John H., twenty months, fourteen hours post-mortem.

Anatomical Diagnoses—Retro-pleural tumor, left, with extension to retroperitoneal tissue. Atelectasis of left lung. Myocardial hypertrophy. Congestion and œdema of the right lung.

Microscopical Diagnoses—Question of papillary carcinoma of the left chest with metastases to the retroperitoneal tissues. Question of mesothelioma.

Body—Is that of a moderately well-developed and well-nourished male infant. The most striking thing about the appearance of the body is a marked asymmetry of the thorax. This is substantiated by measurements, the right side of the chest in the nipple line measuring 23.2 cm from the midline of the sternum to the spinous process of the vertebra, and on the left in a comparable plane measuring 25.7 cm. Likewise at the lower border of the ribs this is also most marked, the left lower ribs flaring out very markedly, while the right lower ribs are normal in appearance. The rest of the body presents no very striking features. The head is essentially normal in appearance. The pupils are equal and regular. The facies are not remarkable. There is no discharge from the ears or nose. There is no cyanosis of the lips or extremities. There is no general adenopathy. There is no œdema. The skin is clear except for a moderate post-mortem lividity in the dependent portions. There is no appreciable rigor mortis present.

The primary incision from top of sternum to pubes reveals a thin layer of normal appearing subcutaneous fat. The musculature is normal in color. On laying back the skin flaps the thoracic deformity is even more marked, but there is no apparent involvement of the ribs themselves as determined by an exterior view.

Peritoneal Cavity—Contains a few cc of excess pale straw-colored fluid. The most striking features of the peritoneal cavity are obscured due to a low position of the diaphragm. The diaphragm on the right is attached along the seventh costal interspace. On the left it is attached along the superior border of the ninth rib, and its surface on the left is convex instead of presenting the usual concave appearance. It extends 3 cm below the costal margin in its most dependent portion. Along the posterior attachment of the diaphragm there is a definite mass of tumor tissue which has infiltrated the diaphragm at that point and extended retroperitoneally into the abdomen. On the right the diaphragm maintains its concave relation, but it is distinctly lower in position than normal, and the entire liver as a result is displaced downward, measuring 9.5 cm in the midline from the tip of the xiphoid and 7.5 cm in the anterior axillary line. The left lobe of the liver is folded back on itself and is entirely to the right of the midline. This left lobe is atrophic in appearance and soft in consistency. There is in the midline

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and extending 3 cm to the left of the midline a retroperitoneal mass of tissue just below the renal vein and in close approximation to the left kidney. This mass is drained by a large vessel emptying into the left renal vein, and over its surface the left spermatic vessels can be traced. There is no definite association of this mass with the suprarenal gland on the left. There are no peritoneal adhesions. The appendix is normal in appearance, retrocaecal in position. The pelvis shows no evidence of pathological changes. (See Fig 9.)

Pleural Cavities—The right pleural cavity contains no free fluid and no adhesions. The left pleural cavity is occupied by tumor mass which will be described, for the sake of coherence, at the end of the protocol.

Pericardial Cavity—The pericardial cavity contains no excess fluid and no adhesions. The heart and its pericardium are displaced to the right and are overlying the right lung to a marked degree, the right border of the heart being 2 cm to the right of the right anterior axillary line.

Heart—Weighs 57 grams. Its epicardium is normal in appearance and contains a moderate amount of fat. The coronary vessels are normal in appearance. The myocardium is somewhat pale and slightly hypertrophied in relation to the size of the infant, this

hypertrophy being largely in the left ventricle. The endocardium is smooth and glistening throughout. There are no valvular defects, and no congenital anomalies.

Thymus—Is present as a discrete gland, and is normal in appearance. It is readily dissected from the pericardium and the great vessels, and shows no association with the tumor.

Right Lung—Weighs 112 grams. Its pleural surface is smooth and its appearance in the gross suggests no pathological changes beyond a slight congestion and œdema, due largely to mechanical conditions.

Left Lung—The pleural surface of the left lung is infiltrated by tumor tissue, which has not definitely invaded the lung substance. The abdominal and pelvic organs present no lesions.

Left Thoracic Cavity—On removing the sternum, a striking picture is presented of the left lung which is greenish-gray in color and completely atelectatic in appearance, being displaced forward and upward in the left chest by a large mass of tumor tissue, apparently retro-pleural in origin. Posterior and lateral to the lung tissue, there is a mucinous appearing hemorrhagic exudate which fills a considerable portion of the thoracic cavity. This fluid is filled with fragmented bits of soft friable necrotic tumor tissue. The tumor itself consists of about a half dozen large nodular masses which invade the thoracic cavity, remaining apparently retro-pleural for the most part. These masses, on section, all present about the same gross characteristics. They are grayish-white in color, but so largely necrotic and infiltrated with hemorrhage that they are usually rather

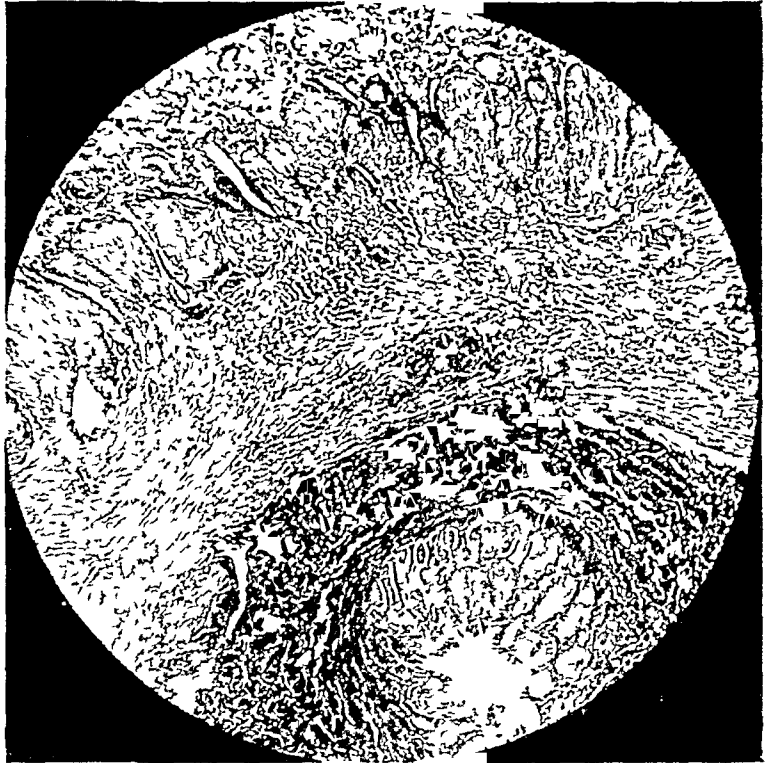


FIG 5—Case I. Low power photomicrograph of abortive intestinal formation showing mucosa and double layer of smooth muscle.

more reddish-gray in appearance, although certain small portions of the tumor do maintain their true color and characteristic nodular arrangement. The entire mass is exceedingly friable and difficult to remove without breaking up. It is firmly adherent to the chest wall from the angle of the scapulæ to the sternal border. After removing the main portion of the tumor there is still found to be a layer of tumor tissue firmly adherent to the periosteum of the ribs and the intercostal muscular fasciæ, which cannot be completely removed except by dissecting off the periosteum. This mass of tumor tissue gives the characteristic grayish-white appearance, not unlike cottage cheese in consistency. The tumor has invaded, as already noted, the diaphragm, and extended to the retroperitoneal tissue, where there is a large nodule of the same gross characteristics and appearance. The mesenteric lymph-nodes are somewhat enlarged and firmer than normal. They do not resemble characteristically the tumor tissue, but suggest the possibility of lymphatic extension. There is no obvious etiology of the tumor mass, and frozen section through a characteristic fragment suggests an embryonal character, the origin of which must remain uncertain. The tumor does not present any definite involvement of the mediastinal tissues. The lymph-nodes on section show no definite involvement. The great vessels are merely displaced laterally and are not involved in the tumor tissue. The sternum contains likewise on its posterior surface a similar tumor nodule which is adherent to the periosteum. At no point, however, does there seem to be involvement of the bony substance of the sternum, ribs or vertebræ.

Microscopical Examination, Heart—Microscopically shows only moderate pathological changes, chiefly a slight œdema. There is no necrosis. There are no metastases of the tumor to the heart. The epicardium and endocardium show no pathological histological changes.

Lungs—The right lung microscopically shows a marked œdema and congestion. There is no evidence of infection secondary to this process, however. The alveoli are largely filled with a serous exudate which on section shows as a fine pink-staining coagulum. The alveolar walls are not thickened. The capillaries are dilated and distended. The bronchi show no involvement. The left lung presents a picture of complete atelectasis. There is no evidence here of infection, and no evidence as yet of disturbances of the blood supply. The pleura is definitely involved in the tumor formation which has not, however, invaded the lung tissue. The tumor will be taken up separately at a later point in order to maintain the continuity of the description.

Thymus—Is somewhat atrophic, the fibrous tissue interlobular septa being extremely prominent and somewhat œdematous. The lymphoid element is slightly diminished in amount in relation to the number and size of the Hassall corpuscles. The latter are prominent, numerous, and vary greatly in size. There is marked phagocytosis present. No other points of particular note.

Tumor—Sections taken through the tumor nodules all show the same striking and unusual histological picture, that of a papillary cysto-carcinoma. The tumor is so extremely necrotic that large areas in many sections taken through this material, show nothing but a semi-necrotized mass of undifferentiable material in which there have been deposited coarse fibrin strands and a polymorphonuclear exudate which is attempting to phagocytize the necrotic material. There is a schizotic background in which one can detect the elements of a stroma, composed of loose myxomatous connective tissue and a generous vascular system. The tumor tissue itself, when well preserved, presents the picture of more or less indefinite alveolar structure, lined by a rapidly proliferating epithelium which grows in papillary projections, sometimes so extensively as to practically occlude the lumen. In other places, the projections are less marked in extent and merely appear as small papillary buds into the lumen. These epithelial cells grow usually as a double layer of epithelium, with a fine connective-tissue stroma supporting them. Certain of the papillary projections measure several mm in length, and they branch in almost mycelial fashion. Some of the papillæ have a cluster of cells at

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their termination, much as a bunch of grapes. Others are more finger-like in their appearance, while the majority of them arboresce in the most profuse and prolific manner. The histology of the individual cells under the high power is that of an ordinary rapidly growing, relatively undifferentiated epithelium with large round or oval nuclei which are relatively deep-staining and contain one or more nucleoli and a generous amount of coarse granular chromatin material. The cytoplasm of the cells is relatively slight in amount for the most part, extending as a narrow rim around the cells, and somewhat paler in color, staining a light bluish-purple with eosin, methylene-blue stain. Others

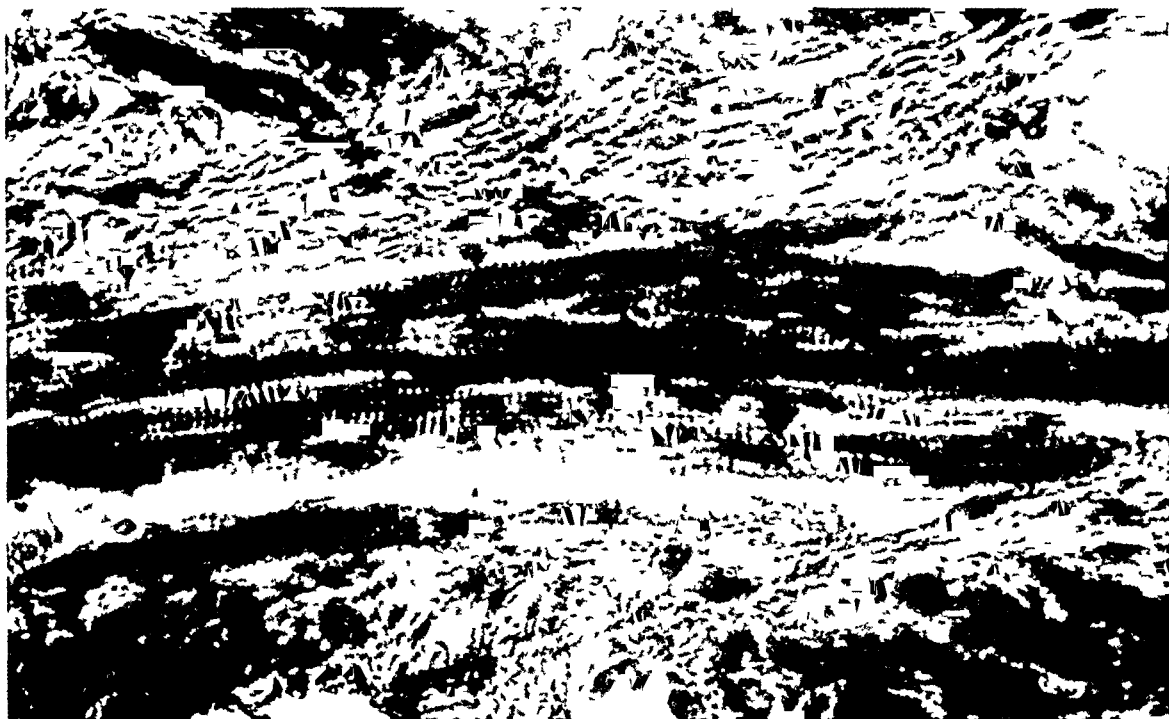


FIG 6—Case I. High power photomicrograph illustrating striated muscle occurring in unrelated bundles in tumor.

possess more cytoplasm, which appears vacuolated, with what are apparently fat droplets within them. In the intercellular spaces there are many mononuclear phagocytic cells which are engulfing fragmented tumor cells and whatever particulate matter is present. The necrotic cells appear as pale, pink-staining, relatively homogeneous cells with their nuclei in various stages of degeneration, from small dark pyknotic fragmented nuclei to large, swollen, pale-staining karyolytic nuclei. The cells have in their normal condition a definite cell outline, but it is largely lost in the necrotic masses. Nuclear figures are abundant, seldom less than three or four per high power field. They are rather striking in that their chromosomes are short, thickened, and frequently almost club-shaped on their ends. Occasional multiple mitoses can be seen. The arrangement of the tissue suggests the appearance of choroid plexus to a rather striking degree.

The stroma of the tumor is made up of a connective tissue which varies in its appearance in different portions of the tumor. For the most part it occurs as fine strands of adult connective tissue in which collagen fibres are relatively dense and adult in appearance. These connective-tissue cells frequently occur in bundles which on cross-section strongly resemble smooth muscle, but by differential staining it is apparent that no smooth muscle is present. In other areas of the tumor the stroma is less adult in appearance, and is myxomatous in character. The stroma is very largely oedematous, and in this oedema there is a moderate precipitation of fibrin in a fine reticular arrangement, in the meshes of which red cells and leucocytes of various types can be seen.

In some sections through the tumor the stroma approaches the embryonal type of mesenchyma, and there is a rapid proliferation of this young connective tissue whose

nuclei are round to oval and distinctly undifferentiated. Also in this œdematous type of tissue there is prominent precipitation of the serum albumins in fine granular form. This extends frequently into the lumina of the tumor alveoli, where also areas of hemorrhage can occasionally be noted.

Sections taken through the atelectatic lung and its superficial pleura show the relation of the tumor to the lung and pleural tissues. It has definitely involved the pleura, thickening it and largely obliterating the pleural endothelium, and occurs in the same papillary adenomatous fashion, but never invading or destroying the lung tissue itself. Likewise the tumor is found to have perforated the diaphragm, and nodules can be seen in the substance of that muscle similar in structure. It is also adherent to the periosteum of the ribs, but has not infiltrated the ribs themselves, nor invaded, except superficially, the periosteal tissue. There is no evidence of metastases elsewhere, except as noted in the gross description by direct extension to the retroperitoneal tissues. There is no obvious etiology for the tumor, nor can one do more than hypothecate in regard to its source. The possibility of ectodermal rests from branchial cleft inclusions (thyroid, thymus, etc.,) must be considered. The possibility of a pleural mesothelial origin cannot be ruled out. The one-sided development of a teratomatous embryonic tumor of blastomere origin likewise must be considered, in spite of the lack of evidence of any other tissue being present.

Tissues are hardened in formalin and Zenker's, and stained by routine eosin, methylene-blue, with phosphotungstic acid hematein, Mallory's connective-tissue stain, and Van Gieson as differential stains.

Clinical Discussion—These two cases present so much in common and are both so unusual that a brief discussion of a few of the more outstanding features seems pertinent.

In the first place, the family history in each instance is entirely negative. There is nothing on careful questioning to suggest even remotely an hereditary etiology. In neither past history is there anything of importance bearing upon the development of the tumor. The second case is in a child so young as to practically preclude any possibility of earlier infection as an activating factor in starting the malignant degenerative changes of the pleural cells, and in the first case there is nothing of an infectious or traumatic character to suggest an early etiology.

Both cases date from an acute onset, simulating pneumonia, and very probably brought to the attention of the physician by an actual pneumonia. In each case this occurred two to three months before admission to the hospital and gave a parallel history of failure to convalesce, as expected in an uncomplicated pneumonia. In each, secondary empyema was suspected by the attending physician and because of that was referred to the hospital for probable operation and treatment.

On physical examination the left chest in each instance was dull or flat over practically the entire extent. In the teratoma case, however, there is some evidence of diminished breathing posteriorly and a suggestion of diminished resonance over the base. Both chests showed definite deformities, and these deformities were among the more important differential diagnostic factors, as the deformity in each case was difficult to reconcile as due solely to fluid. Röntgenograms and fluoroscopic examination before aspiration showed a diffuse shadow in each case with a few denser areas faintly out-

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lined After aspiration of the pleural fluid, the picture suggested an irregular shadow on the left side in each instance with several scattered deeper shadows of probable calcification Even, however, by X-ray examination, the diagnosis of tumor could not be positive The fluid removed by aspiration in both cases was very similar a slightly blood-tinged amber fluid with a consistence of honey, almost mucoid, clinging to the sides of the tube with a specific gravity of about 1010 and containing almost no albumin, albuminoses, or copper-reducing carbohydrates Microscopically, neither con-



FIG 7—Case I Low power photomicrograph of wall of typical epithelial lined cyst, showing cornification of epithelium, coil glands, hair follicle, etc

tained many cells, about 10 per cubic millimetre as a maximum, and chiefly mononuclear in character Each contained flecks of a sebaceous detritus In the teratoma case a few hairs were noted in the last specimen examined, thus establishing the diagnosis

The most important fact which these two cases bring out from the clinical side is the difficulty of differential diagnosis They show the need of extremely careful history taking and physical examination They emphasize the importance of the X-ray, and modern laboratory methods in diagnosis in such obscure conditions

Pathological Discussion From the point of view of the pathologist, tumors of the mediastinum possess a peculiar fascination because of their comparative rarity and the wealth of speculative possibility which they stimulate For that reason these two cases are of particular interest The second

case we can dismiss with only a cursory consideration, as its etiology is so uncertain. From a careful study of both the gross material and the microscopic preparations, a pleural origin is very strongly suggested. In this opinion we are supported by several other pathologists who have seen the histological slides.

Adler,¹ in his discussion of malignant disease of the chest, offers a very complete bibliography. This particular case is younger than any of those mentioned in his monograph, but histologically seems to fall into the group of primary malignant tumors of the pleura. It is probably epithelial in origin rather than from any of the connective-tissue elements, which would classify it as a sarcoma. Our conception of carcinoma does not ordinarily include tumors in as young an individual as this baby. The usual clinical picture associated with true histologic carcinoma is that of a middle-aged individual, although there has been a small group of cases under twenty years of age among those reported.

In the case of the teratoma we have a more definite theory of etiology. Numerous hypotheses have been advanced, the more important being perhaps first, the conception that these tumors arise from ectodermal displacements, pulled down into the chest by the descent of the heart, or second, by some abnormal displacement of cells from one or other of the branchial clefts. This latter view unquestionably may account for certain of the tumors of the neck particularly the epidermoid cysts, but does not seem to be a probable source of true mediastinal tumors. The conception of a blastomere which has become displaced in the course of development is perhaps the most tenable point of view to take. Upon the stage of development of this displaced cell depends the type of tumor which results, whether it shall be a simple cyst of the dermoid character, or a more complex tumor, such as the one described presents or even a greater degree of complexity such as the one von Torok¹⁷ described, in which an abortive foetus resulted. Wilms¹⁸ concludes, from a study of many cases of dermoid cyst, that dermoids of the head, chest, and many of those in the retro-peritoneal tissue, are produced by abnormal development of germinal tissue, with the invagination of epithelium to form glands or by a growth of foetal fission cells. In the abdominal cavity particularly he feels that such teratomata should be regarded as a *foetus in foeto*.

A search through the literature of mediastinal dermoids and teratomata reveals a total reported incidence of only 108 cases. Of these only eight have occurred in children under twelve years of age. Considering the general consensus of opinion in regard to the etiology of these tumors, as of foetal inclusions or incomplete development of blastomeres, it is strange that the majority of these growths do not occur until adult life. And again, many of these tumors are not found until fairly late in life. The extremes reported are from one occurring in a suckling, about which very little definite information can be obtained, reported by Medoer¹² to one in a man of sixty-one, reported by Foa.⁷ Numerous theories have been advanced to account for this discrepancy. Most noteworthy perhaps is the hypothesis that the body

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economy is so actively engaged in promoting normal growth that these displaced cells remain dormant until physical development is complete. At that time the cells then become activated, possibly by some circulating material derived from the endocrine glands associated with the normal physiological changes of puberty, or by some infectious toxin. None of these theories adequately satisfy, but they serve at least as a possible explanation, and fall in line with the more generally accepted theories of neoplastic development.

The ordinary classification of these tumors of embryonal origin is into two

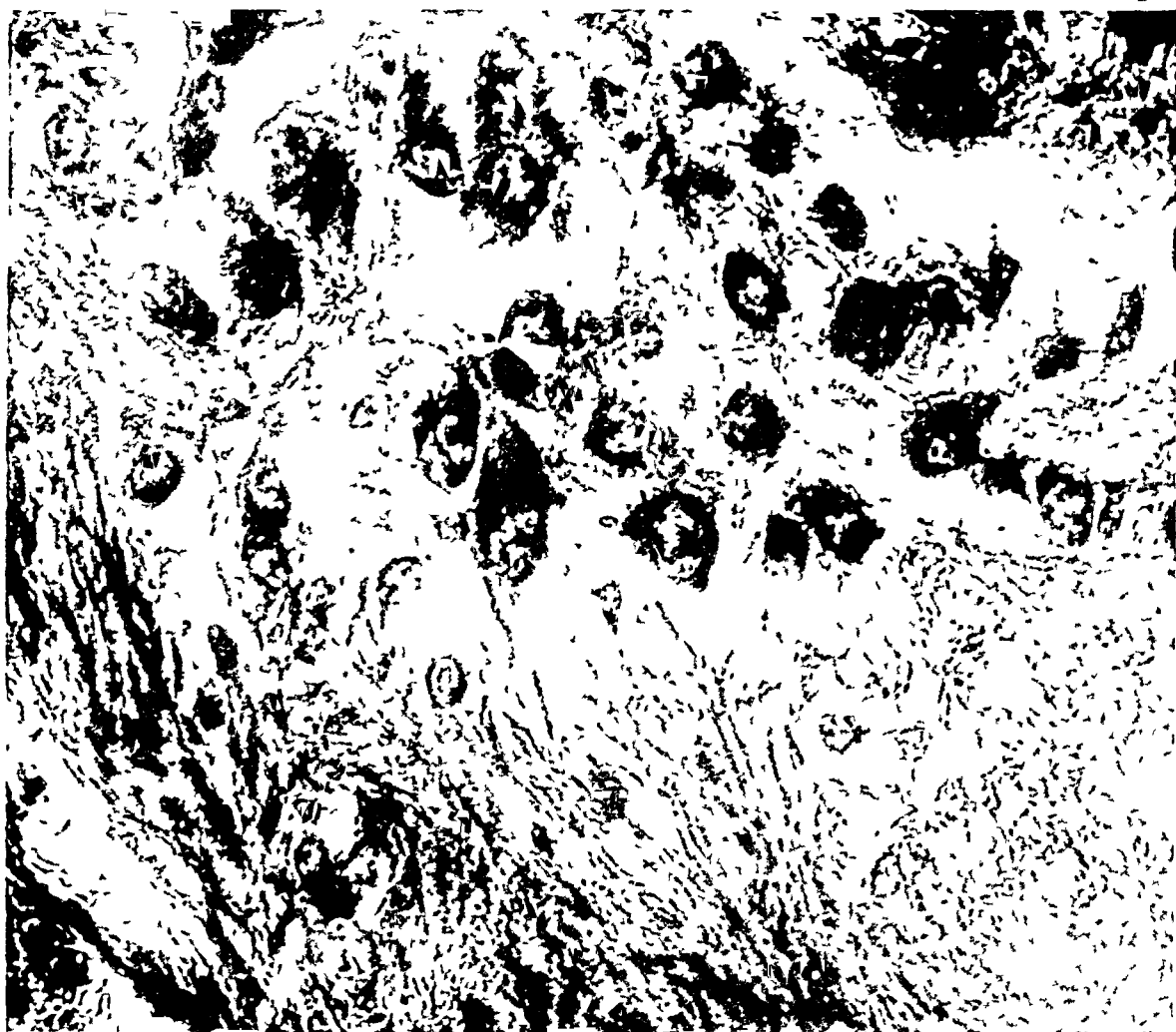


FIG 8—Case I High power photomicrograph of characteristic ganglion cells and nerve fibres found scattered throughout tumor

groups—one of the simple dermoid cyst, and the other the teratoma. This classification is based on a somewhat arbitrary division of the elementary tissues found histologically, and is the same as that employed in these tumors when found in the ovary. The dermoid cyst histologically consists of skin, including both the epidermis and its appendages, sebaceous and sweat glands, and hair, and the connective tissue of the corium with its derivatives—cartilage and bone. These may vary from a simple cyst lined by epithelium to more complex tumors, multilocular in character, in the walls of which may be found a supporting stroma in which cartilage and bone may play an important part, making a veritable frame-work for the various types of epithelium lining

the cysts which may differentiate into sweat glands, sebaceous glands, hair follicles or even teeth

In the group classified as teratomata, the histological diagnosis is only made on finding derivatives of all three germ layers, ectoderm, entoderm and mesoderm. Thus, as in the case presented here, elements representing gastrointestinal tissue or other organs derived from the entoderm, as well as nervous tissue, choroid retinal chromatophores and such ectodermal derivatives, are to be found in addition to the usual mesothelial connective-tissue stroma. This represents a cell inclusion of an earlier type, going back practically to the undifferentiated germ cell, while the simple dermoid represents a later stage in the germinal differentiation.

In a discussion of these mediastinal tumors it would not seem perhaps out of place to include in outline form the other cases which have been reported in children. These are, as previously noted, only eight in number.

The first of these was reported by von Torok¹⁷ in 1900. The patient was a girl of four and a half years of age, who was admitted to the Kinders-Hospital in Vienna with a pre-operative diagnosis of *carcin costarum*. An operation was performed and a tumor mass found in the mediastinum extending into the left pleural cavity, attached to the pleura. It was the size of one's closed fist, and consisted of a cyst with a teratomatous protuberance filling nearly the entire cyst cavity. This was covered by what appeared to be normal skin. Mesially it presented a structure suggesting a head with long tufts of hair and several teeth. In the anterior portion structures resembling intestine were noted. This intestinal tissue had a blind end directly in front of the vertebral column and was filled with mucoid fatty detritus. The tumor was about 12 cm in its greatest length, and 8 cm in its greatest breadth. The hair was fine, blond, and measured 20 mm in length. An attempt to form an alveolar process was noted, with tissue resembling the epithelium of the lip and gums. Several molar teeth, with imperfect crowns, and one well-defined incisor were present in this alveolar process. Microscopically all types of tissue were found, including glial cells, epithelium of ciliated, cylindrical, cuboidal and squamous types.

The second case is that also noted above, reported by Medoei¹⁸ in 1902. This report is incomplete. No note is made of the sex or exact age of the infant, nothing is known of the duration or of the size of the tumor. It was located in the anterior mediastinum and perforated a bronchus. Diagnosis was made by examination of the sputum in which hair was found. The tumor consisted of a cyst filled with fatty brei with a tuft of fine hair and considerable cholesterol. This case obviously falls into the less complex group of so-called "simple dermoid cysts."

The third case was reported by Dangschat¹⁹ in 1903. The patient was a girl of twelve years, who was admitted to the hospital in June, 1899. A chest tap was done at that time and the fluid microscopically showed leucocytes and epithelial cells, chiefly of a squamous variety. Biopsy of the cyst wall microscopically presented a characteristic epidermoid-lined cyst whose epithelium was of the stratified type with definite cornification. No hair, teeth, bone or cartilage were found. A diagnosis of dermoid cyst was made. The patient was living at the time of report, four years later.

The fourth case, reported by von Eiselberg,¹⁶ also in 1903, was a three-year-old child. No history concerning the duration of tumor was noted, and no comment upon the size of the tumor was made. It was located in the anterior mediastinum. It was described as a cystic teratoma with bone and cartilage formation, undergoing sarcomatous degeneration. These findings were made on post-mortem examination.

Madelung¹² in 1904, reported two cases of dermoid of the mediastinum, one occurring

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in a young adult twenty-seven years of age, and the other, with which we are concerned, was in a female child six years of age. This case was living three years after operation. The tumor was thought to have been present since birth. It was described as large and pedunculated, with four distinct parts described in great detail, both grossly and microscopically. It was located in the anterior mediastinum, behind the manubrium, at the level of the second rib. It was roughly conical in outline, covered by shiny white skin, with the previously noted pedunculated masses attached to the main body. The main tumor was covered with epidermis containing many fine hairs, some measuring as much as 22 mm in length. The epidermis presented numerous dimples. The other parts of the tumor were irregular in outline and had essentially the same structure. Microscopically the walls contained epithelium, chiefly of a squamous stratified character. There was some cartilage and bone in the underlying tissue, in which also were imbedded numerous sebaceous and sweat glands, and hair follicles. Thin bundles of smooth muscle fibres were present around the glandular tubes. Some of the tissue closely resembled lymphoid follicles. The tumor was classified as a dermoid cyst by the author.

The case reported by Jones³⁰ was in a male nine years old. Considerable doubt is present as to exact structure of this tumor. It occurred in the supra-sternal region and was considered as possibly of thymic origin. It contained a fatty detritus which suggested a dermoid cyst. No histological examination was reported.

The case of Carpenter,³ occurring in a female child of two, reported in 1906, also falls into the class of simple dermoid tumors. It was known to have existed for a period of about a year, and was the size of a closed fist. It occurred in the anterior mediastinum extending in front of the right lung and was attached to the pleura. It was multi-cystic, the cysts containing fatty detritus and fluid. The walls showed several excrescences, from which fine hair was seen to be growing. In the walls there was a good deal of calcareous deposit, but no actual bony formation.

The eighth case was reported by Prym¹⁴ in 1914. It occurred in a girl eleven years of age, who was operated on for mediastinal tumor in 1912. The tumor was located in the right side of the chest arising from the anterior mediastinum and extending from the seventh to the third ribs. It was adherent to the right pleural surface. Grossly, it was lobulated and the surfaces covered with epithelium. An excrescence about the size of a walnut was present, which was very solid on palpation, and from which grew a small tuft of hair. Suggestion of bone formation was noted with imperfect development of an abortive alveolar process. Histological examination showed characteristic skin with hair, sebaceous and sweat glands. The subcutaneous fatty tissue contained

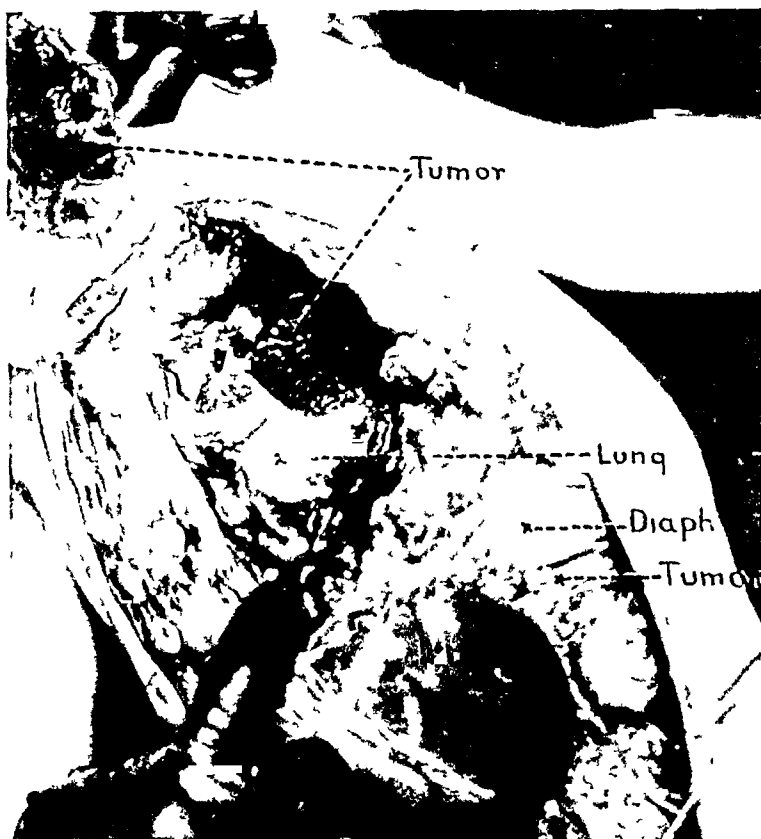


FIG 9—Case II. Anterior view of thoracic and abdominal cavities with sternum reflected in left upper corner. This picture illustrates the approximate extension of the tumor to the abdomen.

some nervous tissue suggesting corpora amylacea or calcified blood-vessels. Tissue which represented a cerebral convolution, with the cells in places arranged like those of the cerebellum, also noted. Neuroglia tissue was present in generous amounts. Chromatophores, tissue suggesting choroid plexus, bone, fat, cartilage, muscle, lymph follicles and other miscellaneous structures were noted. The epithelial tissue ranged from stratified epithelium to high columnar cells, some of them representing mucous goblet cells.

In addition to these above reported cases there has come to our attention in the past few months another case of mediastinal dermoid of a boy of fourteen. This was diagnosed in the pathological laboratory of the Harvard Medical School by examination of the aspirated fluid from the chest, and was operated on with very satisfactory immediate results. The case is still under observation and sufficient time has not elapsed to warrant further discussion. We are indebted to Dr J. Homer Wright⁷ of the Massachusetts General Hospital for a post-operative description of the tumor.

An analysis of these eight cases and the one reported here is interesting. Six of the nine cases occurred in females, in two of them the sex was not noted in the reports, and only one definitely was found in a male. This is somewhat in contrast to the distribution between the sexes in the entire group of 108 cases, which have been reported, where the distribution is found to be nearly equally divided, forty-one being recorded in females, forty-three in males, and no sex noted in twenty-four. Again, of these nine cases occurring in children, five are simple dermoid cysts, while the other four show more complex structural characteristics which warrant their inclusion in the group of teratomata. One of these latter represents chiefly a dermoid cyst, but this showed malignant degeneration. It was classified by the author as a cystic teratoma with sarcomatous degeneration.

The age incidence is another feature of interest, five of these occurring in children under ten, thus even further restricting the group if we think in terms of decades. The age incidence of the total 108 cases falls into the following groups, arranged by decades: 0 to 10, 6; 11 to 20, 16; 21 to 30, 43; 31 to 40, 7; over 40, 10; not recorded, 26.

The clinical histories of these cases are in most instances very unsatisfactory. In only one of them is any definite knowledge of the duration recorded. In two of the others an approximate conclusion is drawn, without any very definite basis. The size of the tumors again is of some interest, ranging in those whose size is recorded, from a walnut to our case which measures 15 x 11 x 9 cm. The location varies somewhat, the tendency, strangely enough, being for these tumors to occur on the left side of the chest rather than the right, in spite of the resistance which one would think the heart would offer to growth in that direction. They all apparently originate in the anterior mediastinum, somewhere about the level of the second or third rib, and extend from that point upwards, in the case reported by Jones to a suprasternal position, laterally in five cases, four being to the left, and one to the right. In three it is not recorded, and in one it remains localized to the anterior mediastinum.

⁷ Personal communication.

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The gross appearance again varies so much as to be scarcely worth while elaborating. Roughly, they are ovoid or spherical in outline, tend to be lobulated, usually adherent to the pericardium and pleura, are always cystic, occasionally unilocular, in the more complex ones multi-lobular. Their diagnosis is usually confirmed by finding hair or sebaceous material by aspiration or in the sputum. These are perhaps the more important features noted in these mediastinal tumors.

The literature has been variously reviewed at irregular intervals by workers who have been stimulated by finding such a case. Christian,¹ in 1907, reported in the *Journal of Medical Research*, an analysis of the forty cases which he could find up to that time. No further complete review of the literature was made until 1916 when Hertzler,² in the *American Journal of Medical Sciences*, reported a case and summarized the literature up to that time. Again, in 1919, Harris,³ in the *Ohio State Medical Journal*, supplemented Hertzler's bibliography by numerous other foreign reports which had not been previously included, and likewise included the cases occurring from the time of Hertzler's publication.

Since the original writing of this report in 1922, Murphy⁴ has presented a paper in which several cases not previously recorded are found. Only one of these strictly falls into the age group which we have discussed, but his own and one other are both in children under fifteen and are for that reason mentioned for the sake of completeness.

Murphy's case unfortunately could not be confirmed histologically, as she died before being operated upon and post-mortem was refused. The case was in a girl of thirteen and the course was rapid, covering a period of

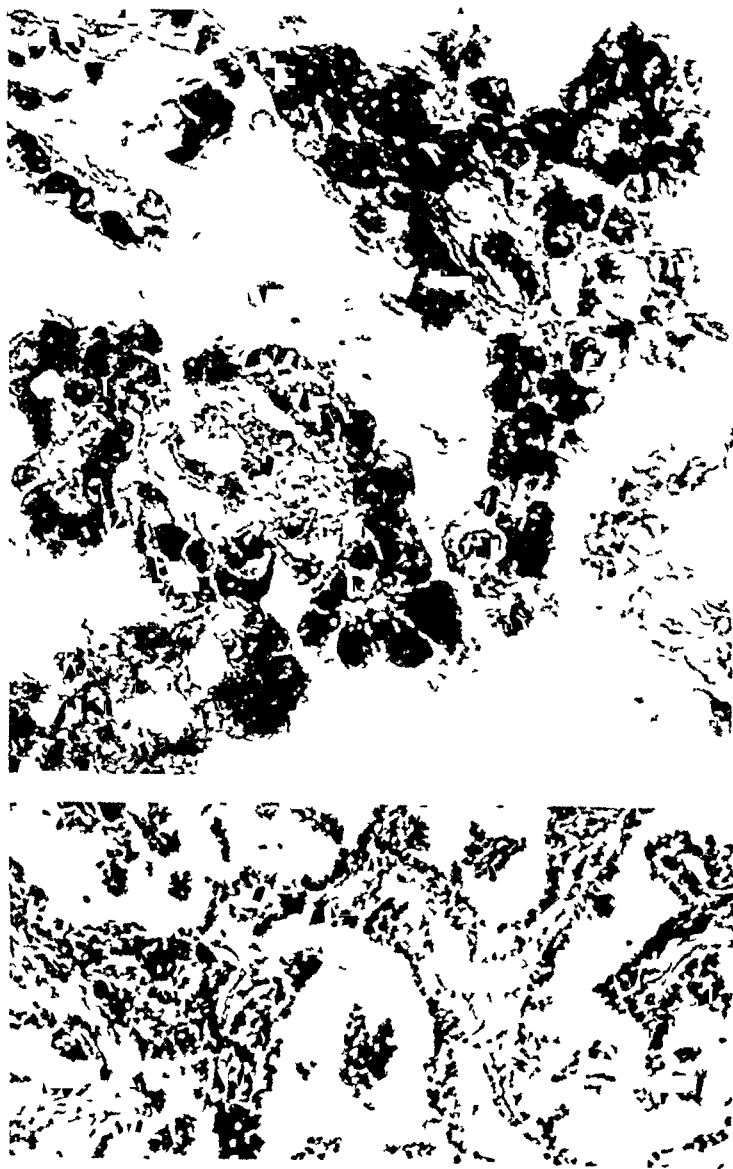


FIG 10.—Case II. High and low power photomicrographs of tumor illustrating the typical papillary arrangement of the tumor cells.

six weeks, strongly suggesting the possibility of a thymic or lymphatic tumor. She was treated by X-ray, without benefit.

Kahn²⁰ reports a case in a girl of fourteen, and Pohl,²¹ in 1914, gives the details of a similar solid teratoma in a girl of ten. His case came to autopsy and was proven histologically. At that time he commented on finding only two other similar cases in the literature up to that time. One of these was in a boy of fifteen reported by Virchow,²² the other in an older patient.

Whittemore,²³ in 1923, gives the history of the case referred to from the Massachusetts General Hospital.

Several other cases in adults have been reported. No attempt is made to cite all of these in the appended bibliography, as this paper is intended only to record those cases occurring in children. In this respect every effort has been made to make it as complete as possible, verifying the cases by referring to the original papers for the most part. Unquestionably, omissions will be found, for as the data accumulates, cases under obscure titles will be brought to light. Already the total of the reported cases approaches 125, and we can see that the condition is not so rare as it was thought to be, even ten years ago.

Conclusions Two cases of mediastinal tumors in children are reported. The difficulty of differential diagnosis is emphasized, requiring the use of modern laboratory methods. The only treatment of these tumors is surgical, if they present symptoms due to pressure.

A review of the other mediastinal dermoid cysts and solid teratomata in children is presented and a discussion of their etiology is given.

BIBLIOGRAPHY

- ¹ Adler, I. Primary Malignant Growths of Lungs and Bronchi. Longmans, Green and Company, London, 1912.
- ² Black, H. R., and Black, S. O. Pulmonary Teratoma. *ANNALS OF SURGERY*, 1918, vol. LVII, p. 73.
- ³ Carpenter, G. A Case of Dermoid Tumor of the Mediastinum in a Child, Aged Two Years. *Lancet*, 1906, vol. 1, p. 295.
- ⁴ Christian, H. A. Solid Teratomata of the Mediastinum. *Jour. Med. Research*, 1907, vol. XVI, p. 275.
- ⁵ Dangschat, B. Beitrage zur Genese, Pathologie und Diagnose der Dermoidcysten und Teratome im Mediastinum anticum. *Beitr. z. klin. Chir.*, 1903, vol. XXXVIII, p. 692.
- ⁶ Duvall, Pierre and Clerc, Antonin. Un cas de Kyste dermoïde du médiastin antérieur guéri après extirpation totale par voie transpleurale. *Bull. and Mem. de la Soc. Med. des Hosp. de Paris*, 1921, p. 1147.
- ⁷ Foa. Ciste ateromatose del mediastino in un'alcinata cronica emofilica. *Il Margagnoli. Giornale Indirizzato al Progresso della Medicina*, 1874, vol. XVI, p. 498.
- ⁸ Harris, I. B. Mediastinal Dermoid with Report of a Case. *Ohio State Med. Jour.*, 1919, vol. XV, p. 547.
- ⁹ Hertzler, A. E. Dermoids of the Mediastinum. *Am. Jour. Med. Sc.*, 1916, vol. CLI, p. 165.
- ¹⁰ Jones, T. Post-sternal Tumor. *Brit. Med. Jour.*, 1880, vol. 1, p. 286.
- ¹¹ Kleinschmidt, O. Dermoides der Mediastinum. *Munch. Med. Wchnschr.*, 1920, vol. LVII, p. 862.

TUMORS OF THE MEDIASTINUM IN CHILDREN

- ¹² Madelung, O W Ueber Extirpation eines Dermoid des Mediastinum anticum Beitr
z klin Chir, 1903, vol xli, p 217
- ¹³ Medoei Berl klin Wehnschr, 1902, vol xxxix p 719 Budapestter Brief
- ¹⁴ Prym, P Ein Teratom in Vorderens Mediastinum Frankfurt Ztschr f Path.,
1914-15, p 181
- ¹⁵ Sonnenschein, R Dermoids of the Anterior Mediastinum, with Report of a Case
Ann Otol, Rhin and Laryng, 1920, vol xxix, p 427
- ¹⁶ von Eiselberg, Freiherr Zur Therapie der Dermoide des Mediastinum anticum Arch
f klin Chir, 1903, vol lxxi, pp 575-590
- ¹⁷ von Torok, Guido Teratom der Brusthohle (Fœtus in Fœtu) Ztschr f Heilkunde
(Abtheilung f Chir), 1900, vol xxi, p 263
- ¹⁸ Wilms, Max Ueber die Dermoidcysten und Teratome, mit besonderer Berücksichti-
gung der Dermoide der Ovarien Deutsches Archiv f Klin Med, 1895, vol lv,
p 289
- ¹⁹ Murphy, J T Dermoid Cysts of the Thorax Journal of Radiology, 1922, vol iii,
p 8
- ²⁰ Kahn, M X-ray Studies of Mediastinal Shadows with Special Reference to Dermoid
Cyst Journal of Radiology, 1922, vol iii, p 93
- ²¹ Pohl, W Über Mediastinal-Dermoide Deut Zeitschrift fur Chir, 1914 vol cxxx,
p 481
- ²² Virchow, Rud Teratoma myomatoides mediastini Virchow Archiv, 1871, vol liii,
p 444
- ²³ Whittemore, W Teratoma of Right Chest Cavity Arch of Surgery, 1923, vol vi,
p 282
- ²⁴ Delesert, E A Clinical Study of Malignant Tumors of the Anterior Mediastinum and
Thymic Region Internat Clinics, 1922, vol ii, p 127
- ²⁵ Moons, E Dermoid Cyst of Anterior Mediastinum Arch Franco-Belges de chir,
1922, vol xxv, p 959

THE TREATMENT OF SUPPURATIVE PERITONITIS*

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THE selection of this subject is not altogether my own. I have been told, however, that there are still different views in regard to the treatment of peritonitis and that it would be interesting to compare my present views with those I expressed some twenty years ago.

In 1903, I read a paper on this subject before the American Surgical Association† and in another paper, read a year later,‡ reported additional experience with the treatment I had advocated. In these papers a definite distinction was made between cases of diffuse peritonitis and localized peritonitis. The term diffuse peritonitis embraced the cases of so-called spreading peritonitis, in which there is no limitation of the process by adhesions or gravitation but in which the limits are ascertainable, and cases of generalized peritonitis in which no part of the peritoneum excepting the lesser sac can be demonstrated as free from invasion. The term local or localized peritonitis was applied to cases with abscess, in which there is a localized collection of pus with limiting adhesions.

Too much emphasis cannot be laid upon the differences in the treatment of these two groups. A local peritonitis is essentially an abscess, a walled-off process, and should be treated by evacuation and efficient drainage. Being localized, removal or suppression of its cause is not always absolutely necessary. In fact, as we know, it may add unjustifiable danger to the operation.

On the other hand, diffuse peritonitis is an unlimited process in that its cause is still operating to promote its progression in both degree and extent, and therefore its cause should be suppressed or removed. In diffuse peritonitis the intensity of the process, except in the immediate vicinity of the cause, has rarely gone on to the point of necrosis and pullulation of bacteria in the tissues of the peritoneum, because the patients succumb before such a degree of infection becomes extensive. In other words, the large surfaces exposed to perhaps even a purulent exudate, even though irritated and congested, are contaminated rather than infected.

Rational methods of treatment must be based, with due consideration, upon these differences between localized and diffuse peritonitis. Twenty years ago almost universally, cases of diffuse peritonitis were treated like cases of local peritonitis and as many drains were introduced as there were fossæ or pockets in the peritoneal cavity. Sometimes glass, sometimes rubber tubes,

* Read before the New York Surgical Society, January 23, 1924.

† ANNALS OF SURGERY, August, 1903.

‡ New York Medical Journal and Philadelphia Medical Journal, November 19, 1904.

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but not unfrequently gauze packings were considered proper appliances for drainage. The role drains played in producing traumatism and establishing infection was not appreciated. Evisceration and cleansing the cavity with sponges was frequently practised. The mortality was distressing.

About this time Ochsner described his method of prociastination in the treatment of peritonitis which was based upon the principle that physiological rest of the alimentary tract tends toward localization and even resolution of diffuse peritonitis. It was a great contribution to our knowledge of the pathology and treatment of peritonitis, but I have always believed it should not be employed when the cause of peritonitis could be removed. For, as has already been mentioned, the infected organ from which the infection extends in a case of diffuse peritonitis continues as a source of infection, and areas which at first are simply contaminated finally become infected. Furthermore, in those early days, operations for localized peritonitis, that is abscesses, were attended by far less mortality than were those for diffuse peritonitis, so that it seemed desirable to wait for localization. With our present methods, I believe the converse is true and that the prognosis of operations for local abscesses, at least those of appendical origin, is more grave than that of operations for the average cases of diffuse peritonitis of similar origin.

The dangers of prolonged suppuration in the peritoneal cavity may be divided into two categories, firstly, those arising from extension of infection such as portal phlebitis, subphrenic and other secondary abscesses, perforations and infection of other organs and all the other sequences of chronic sepsis, secondly, those caused by repair or by operation, such as adhesions, intestinal obstruction and post-operative ventral hernia. These dangers are as a rule avoided if an early operation is done and the origin of the infection suppressed.

My contention as expressed in 1903, in regard to the usual cases of diffuse peritonitis in which the cause could be suppressed, was that given a short anaesthesia and a quick operation the danger of interference was much less than that of procrastination, and I do not believe any reason has developed since for changing that view, with the exception of some cases of gonococcus and pneumococcus peritonitis which I shall consider later.

One of the advantages of an early operation is the avoidance of the necessity for drainage. Of the 32 cases of diffuse peritonitis reported by me in 1903 a comparison showed that the duration of convalescence in the undrained was about three-fifths of that of the drained. My practice was to use drains only when the presence of necrosis or hemorrhage demanded it. A rule I had was that after removing the cause and cleansing the peritoneum drainage should not be employed unless there were areas of necrotic fibrin such as form the walls of an abscess or bleeding which could not be controlled except by packing. In other words if all of the peritoneal surface was practically alike, drains should not be used. If in strong doubt, drains were to be used. When I speak of drainage I mean drainage of the peritoneal

cavity or parts of it. In all my cases the wounds in the parietes were drained, the drains passing just into the peritoneal cavity. This method has since proved to be correct in the treatment of suppuration of the joint and pleural cavities.

Abscess cavities, areas in which on account of necrotic fibrin or tissue continued suppuration cannot but take place, and leaking organs should be efficiently drained preferably by a doubled rubber tube, so that the necrotic material may be washed out as soon as it separates.

Cleansing the peritoneum is important if it can be carried out without causing injury or unduly prolonging the operation. One would not tolerate leaving gastric contents, food, or fæces in the cavity, nor should one leave quantities of blood or pus. In 1903, I advocated peritoneal lavage, using large quantities of saline introduced with a tube or poured from a pitcher and mopped out with gauze. By 1904, I used a two-way irrigator, the excess fluid being removed by siphonage. This was a great improvement over the former method, as practically no traumatism was inflicted. The present mechanical suction apparatus with which nearly every hospital is equipped, affords a still more rapid and efficient means of cleansing, for the saline only has to be poured in from a pitcher and almost as rapidly removed.

At present I do not attempt to be as thorough in washing out the cavity as I formerly was. I usually am content with rinsing the immediate vicinity of the site of operation unless I have reason to believe foreign materials or pus have been spread further. However, considering our present conception of contamination and infection, it would appear reasonable to remove contamination to the extent of our ability.

In some cases, such as almost moribund cases of appendicitis in which prolongation of the operation by every moment counts, all considerations as to ventral hernia or shortening convalescence must be disregarded and only so much done as is likely to turn the tide of infection—simply a drain to the appendix, or if it is readily accessible its removal and a drain may be sufficient. Local drainage only should be employed. Multiple drainage incisions are absolutely contra-indicated. The chances for recovery are better if the outlying regions of the peritoneum are untouched. Resolution throughout is more apt to result, and even if local abscesses form, they are more safely dealt with as they become evident. The cases of so-called fibrino-purulent peritonitis are cases in point. It is foolhardy to break down the adhesions and either wash out or drain all the pockets. The mortality although great, is less if the cause alone is removed and the outlying pockets left to resolve or form abscesses to be opened later.

Ileus is one of the most distressing and dangerous complications of peritonitis. Usually of the paralytic type alone, it may become virtually obstructive more frequently of the angulation type, because of kinking at adhesions of the distended loops. The other types, except possibly that

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caused by drainage tubes (compression ileus), do not particularly interest us in the treatment of peritonitis itself. Many deaths attributed to the septic intoxication alone of peritonitis are immediately caused by ileus and its depressing action upon the vitality and resistance of the patient. It becomes the determining factor in the vicious circle of sepsis, meteorism, stasis, putrefaction of intestinal contents, septic intoxication. If not present before operation it should rarely occur after, for it is usually caused by unnecessary roughness and thoroughness in operating. When present before operation, it is more than likely increased by the operation and demands serious consideration. Formerly, I was satisfied with opening the small intestine, emptying the adjacent coils through the incision and then closing. I have come to the conclusion that this was bad surgery, because ineffectual and necessitating too much handling of the intestines. I now introduce a 20 F to 24 F catheter as near as possible, by guessing, into the middle of the ileum or distended coils of small intestine. The wall of the intestine is inverted by a couple of purse-strings and no attempt to empty the gut is made at the operation. This drainage of the intestinal canal has saved almost more lives, I believe, than have the drains put into the peritoneal cavity. At least, it has not killed so many. My custom has been to leave the catheter open, it draining continuously into a bottle by means of a connecting tube and extension, and to irrigate the intestine every two or three hours with water, always leaving a few ounces remaining in the gut.

My routine treatment otherwise is the ordinary post-operative treatment following abdominal operations, namely, an ampoule of surgical pituitrin every four hours for six doses, gastric lavage and colonic irrigations when indicated. In case of colonic irrigations they should be timed to be begun fifteen minutes after a hypodermic of pituitrin, in case of an enema, one-half hour after. If irrigations or enemata are indicated after the initial six doses of pituitrin, an additional ampoule of pituitrin is given before each.

Reference has been made to gonococcus and pneumococcus peritonitis, as presenting peculiarities which require treatment differing from the ordinary types of suppurative peritonitis. In both of these infections the organisms are not so virulent or so dangerous as are the pyogenic bacteria. The chances of resolution and localization are accordingly greater and the need for early operation less. The difficulty is in making a diagnosis. If it can be made and one is sure he is dealing with one of these forms, delay in operating is frequently advisable.

Pneumococic peritonitis may be idiopathic, at least no atrium of infection can be demonstrated and, therefore, there is no advantage in, but on the other hand, distinct contra-indications to operation before localization has taken place and an abscess can be opened. In cases of appendical origin which, in fact, are generally mixed infections of course operation to remove the cause is indicated.

In cases of tubal origin just as in cases of gonococcic peritonitis, if operated on during the acute diffuse stage, I have found the mortality very high, unless the tubes were removed. When the tubes were not removed, drainage was employed. When the tubes were removed the abdomen was closed without drainage. Most of the former died and all of the latter recovered. The outcome of these cases again justifies the opinion that in diffuse, spreading peritonitis, operation is not beneficial unless the atrium of infection can be suppressed, and also that drainage tends to continue and accentuate infection.

In conclusion, I wish to emphasize the importance of making accurate diagnoses so that operation when indicated, can be planned so as to eliminate the cause with the least loss of time and the least traumatism.

I shall also add that no absolute rules or maxims can be laid down. The best results will be obtained by those who combine judgment and knowledge of the reaction of tissues and organs to infection and injury with diagnostic acumen and technical skill, which are in fact the attributes every surgeon should possess.

THE VALUE OF THE RONTGEN EXAMINATION IN THE EARLY DIAGNOSIS OF POST-OPERATIVE ILEUS*

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There are few incidents in the post-operative course of a surgical case more distressing than the calamity of acute intestinal obstruction. As one writer has put it, after a patient has undergone the mental and physical strain attendant upon a severe surgical operation, and has just begun to feel the satisfaction and physical benefit consequent upon having passed safely through such an ordeal, to be called upon again to submit to further greater surgical hazard is to stretch almost to the breaking point the fortitude and the physical endurance of the hardest. It is true this experience comes to the surgeon with much less frequency now than formerly thanks to numerous improvements in the technic of preparatory and surgical treatment. Particularly has this been true in our own surgical work since the abandonment of the practice of pre-operative catharsis. As one familiar with the striking difference in the peristaltic behavior and gas-content of the gastro-intestinal tract as seen with the X-rays in cases with and in cases without purging the writer early adopted the plan of giving no preliminary preparation of the bowels.



FIG. 1.—Very marked distension of the colon with gas in a case thought to be acute small intestinal obstruction. The gas distention was relieved by washing out the colon and the administration of purgative extract. The distribution of the gas and fecal matter is characteristic of the bowel outlines and gas content after relief of obstruction.

* Read before the Western Surgical Society, December, 1923.

other than by cleansing enemas, except in a very few cases where the history of the nature of the lesion seemed to call for a different program of preparation for surgery

The most experienced surgeon at times feels much uncertainty as to the nature of an acute abdominal lesion when characterized by apparent obstruction of the bowel, and yet the patient's chance of recovery depends most of all upon the early recognition of the fact of obstruction, should it prove to be a case of ileus. If one delays long enough, following an abdominal operation

the occurrence of inhibited bowel activity, accompanied by progressive abdominal distention beginning within twenty-four hours, unrelieved by ordinary remedies, continuing in a most obstinate and progressive manner during the second, third and fourth days with rapid pulse, increase in temperature and rate of respiration, restlessness, cold perspiration, vomiting of dark material, sometimes with fetid odor, but without the passage of gas or fecal matter from the bowel with finally tense distention of the abdomen leaves no doubt as to the existence of an acute post-operative ileus! Even the passage of gas and fairly satisfactory bowel movements does not ex-



FIG 2—Acute obstruction high up in the small intestine somewhere near the junction of the jejunum and the ileum. Note the absence of gas-distended coils in the lower half of the abdominal shadow.

clude an obstruction which may have occurred high up in the small gut. This obstruction may be a parietic condition, due, for instance, to infection or it may result from mechanical conditions.

In the treatment of post-operative ileus early recognition of the condition is of the greatest importance in order that the profound general depression attending the later stages of obstruction may be minimized or averted. The effect of the time element in these cases is graphically shown in all statistics by the steady increase in the mortality rate which accompanies the lengthened interval allowed to pass between the occurrence of the obstruction and opera-

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Fig. 3—Marked gastric dilatation. Acute obstruction low in the small bowel, yet a little distance above the ileocolic junction. One determines this by the distribution of the gas-distended coils. The trace of barium in the cecum remained there from a pre-operative barium meal study.



Fig. 4—Very high grade of acute obstruction near the ileocolic junction. The dilatation of the entire small bowel in this case was extreme.

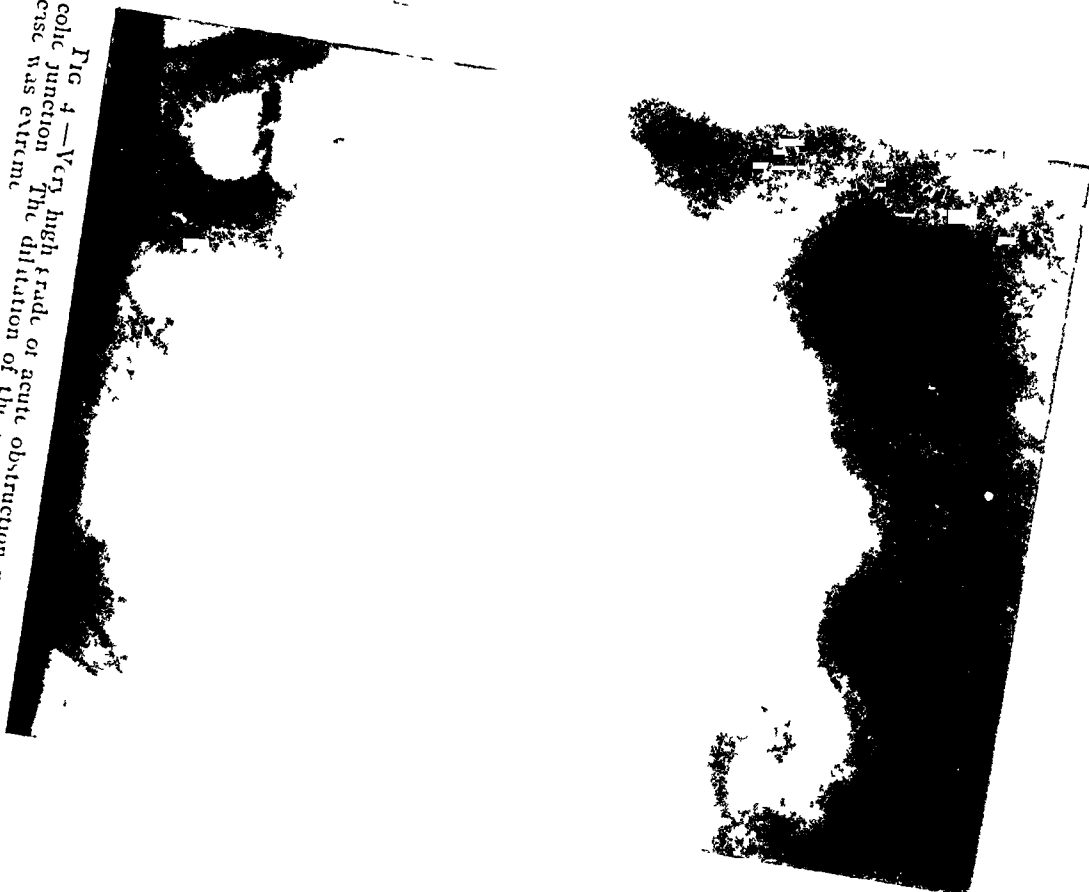




FIG 6 — Acute post-operative ileus. plate made immediately after the administration of one ounce of barium stirred in water (a) Stomach (b) Numerous coils of gas distended intestine characteristic of acute intestinal obstruction Nevertheless operation not yet decided upon See Fig 7 Gas distended ileum differentiated from colon (c) by feathery outline Colon characterized by haustral markings

FIG 5 — Acute obstruction in the small intestine in which the decision to operate was not made until the second examination six hours after the first. Meanwhile a small amount of barium had been given and the characteristic appearance of the small bowel visualized

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tive intervention. It is the purpose of this paper to describe a simple quick method which is nowadays universally available for shortening the time of observation before reaching a decision to intervene.

Naturally every surgeon regards with suspicion any untoward post-operative symptoms, one or more of which occurs to some degree in the majority of abdominal cases. A complaint of fullness particularly in the epigastric region accompanied by vomiting or frequent gagging or gulping of small quantities of dark fluid, or any one of a number of other symptoms belonging to the category of symptoms of possible ileus becomes at once a cause of disquietude. If twenty-four hours can be saved in reaching a decision in a case requiring further operation, great help has been rendered. The method hereinafter described can render such help.

While recognizing the comparative certainty with which intestinal obstruction can be diagnosed from the clinical and physical examination, the necessity for making the earliest possible decision to operate or not to operate, impels the writer to venture to again call attention to his experience in the employment of the X-ray examination as a

diagnostic adjunct in these cases. In 1910, he began the use of the X-ray study with the present technic in cases of suspected ileus especially when surgical interference was not clearly indicated. These observations were reported in 1914, before the American Rontgen Ray Society and in 1915 at the San Francisco meeting of the American Medical Association. The simplicity and safety of the procedure has been freely admitted by a number of prominent surgeons but rather extensive visitation among the leading hospitals of this country gives the impression that the surgeons for the greater part continue operating late though without exception deprecating such late operation and advocating early intervention. It requires no small degree



FIG. 7.—Same case as shown in Fig. 6, six hours later. (a) Distended coil of jejunum more clearly shown up by barium. Enterostomy. Cure.

of courage to face the patient and the friends and go in again after the abdomen has once been closed

It is not claimed that the X-ray test here described will differentiate with surety between the paralytic and the mechanical forms of ileus, nor that the exact site of the obstruction will be made clear, but the one essential fact which can be determined with reasonable assurance is the presence or absence of obstruction Does it exist or does it not?

This method of study is gaining ground in European surgical clinics

Gosset of Paris is using it Guillaume (Bull et mem Soc anat de Par, vol xviii, p 511, Dec, 1921) notes that roentgenographic study of the gastro-intestinal tract is rarely carried out in such cases, perhaps for fear of producing serious reactions by the administration of opaque test-meals However, the ingestion of barium-mixed broth is not necessary to the examination The films made with the patient in the supine position, without an opaque meal, reveal the contours of the intestine plainly enough to establish the diagnosis One of the German clinics has now studied more than a hundred cases in this manner

The technic which we first described in 1914,



FIG 8—Acute small intestine obstruction upper abdomen attending gangrene of cæcum in case of carcinoma of sigmoid, showing gas distended stomach and three parallel reaches of enormously distended small bowel crossing upper abdomen Death in spite of operation

with slight modifications made possible by improvements in X-ray apparatus, is as follows Counting the day of operation as the first day, given a patient on the third day after operation presenting symptoms suggestive of acute intestinal obstruction, the portable Rontgen apparatus now available in most approved hospitals is wheeled into the patient's room, a fourteen by seventeen inch film with screen, in the proper film-holder, is slipped beneath the patient's abdomen, the interiliac line being slightly below the middle of the film No dressings are removed, and, if the patient's condition requires it, even the bedclothing may be replaced once the X-ray tube is centred over the middle

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Fig. 9—The fact of intestinal obstruction is definitely shown in this case without any barium. Yet because of the indecision regarding the need of operation barium was administered and another examination made twelve hours later. See Fig. 10

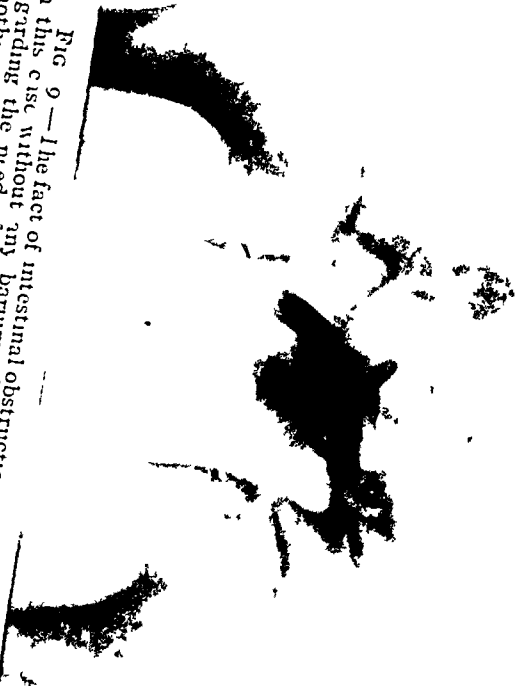
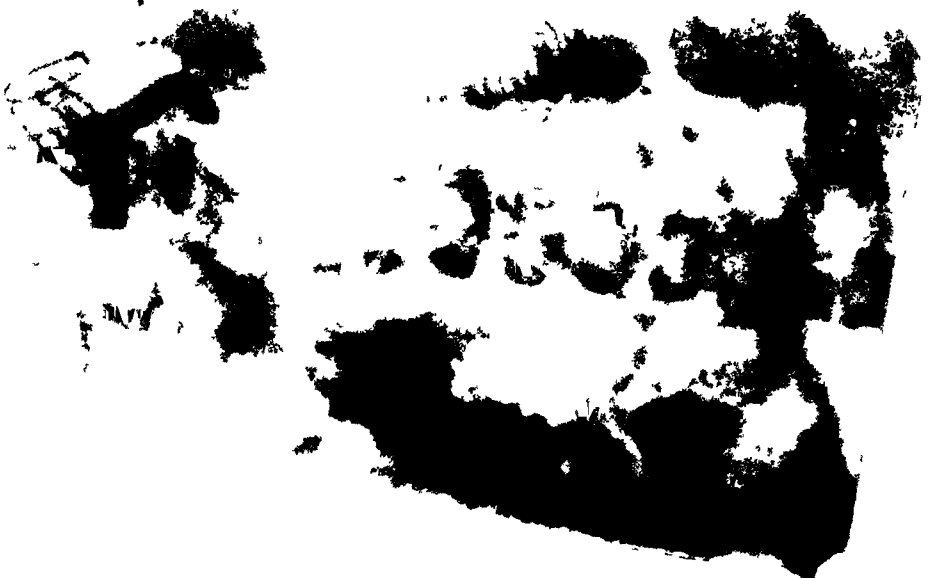


Fig. 10—Same case as Fig. 9, except that the barium now visualizes the distended small intestines. The operation which was then done had been unnecessarily delayed twelve hours.



of the abdomen. The patient is asked to hold the breath for a few seconds, the exposure of two to four seconds is made, the film removed and the apparatus taken from the room at once. The whole procedure need not require more than five minutes. The film is at once developed, and it may be studied immediately after being dipped in the fixing solution. Thus the surgeon may within fifteen minutes from the time he desires it study a roentgenogram of the patient's abdomen, without any more disturbance to the patient than that incident to a slight change of position in bed. No preparation

of any kind is required.

The developed film will reveal at once whether there is any gas distention of the bowel or stomach, and if so, whether the distention occurs in the stomach, or in the large or small intestine. Enormous gas stretching of the stomach is occasionally seen, and the absence of such a gastric gas accumulation at once rules out post-operative dilatation of the stomach. Small and large bowel may be distinguished by the characteristic outlines of the gas areas. The haustral markings as well as the peripheral distribution of the gas along the course of the colon rather than

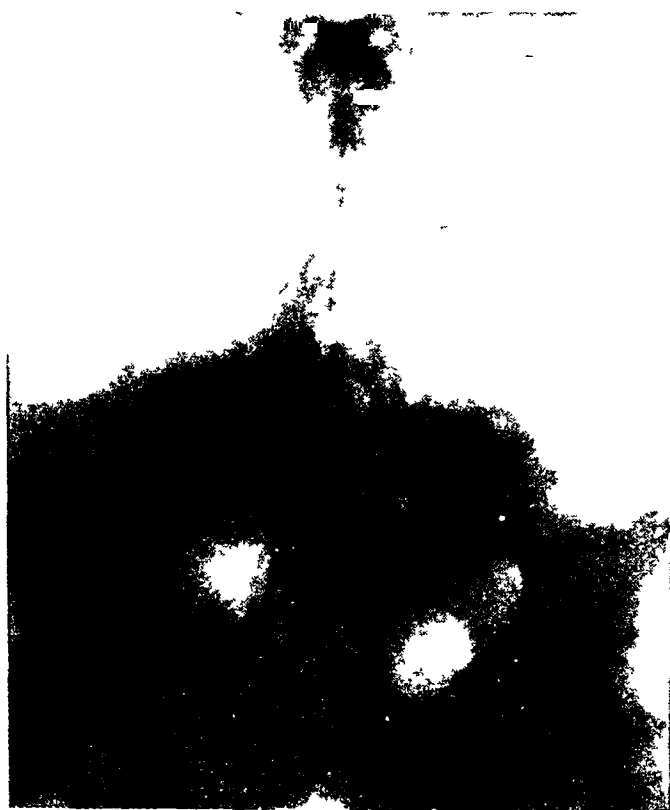


FIG. 11.—A case in which the gas distention was shown by the roentgenogram to involve both small and large intestine. Under non-surgical treatment the gas distention was relieved. See Fig. 12.

in the middle of the abdomen, are sufficiently characteristic to identify the large bowel. Equally characteristic is the appearance of the gas-distended coils in acute obstruction of the jejunum or ileum, the coils are more or less parallel and the caliber of the small gut is increased to one and a half or two or even three inches as measured on the X-ray film, and when it is recognized that this film is a life-sized record of the actual measurements, with only slight distortion, it is easily seen that such increased diameters of the bowel shadows mean actual distention to the degree indicated. It is seen that the distention is not confined to a short segment of the intestine but involves one or more feet, usually several loops. Of course, a certain amount of post-operative distention of the small intestine is frequently noted where there are no symptoms suggestive of obstruction, but in the serious

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cases the degree of distention is at once apparent and suggestive. Paralytic ileus in some degree probably exists in a much larger proportion of abdominal cases than is usually believed to be the case, relief being obtained during the post-operative routine management of the case without being definitely recognized.

The serrated contour of the small intestine is characteristically different from that of the colon due to the markings of the haustra coli, so that we should be able to recognize at once and differentiate acute post-operative gastric dilatation and obstruction in the small or in the large intestine.

Observation of the caecal region is especially helpful, for if the caecum contains gas, it is not likely that the obstruction is in the small bowel. The case illustrated in Fig. 11 is very instructive on this point. Most of the gas is contained in the caecum, yet the coils of distended small intestine occupying the left side of the abdomen are clearly seen. Redoubled efforts to get the bowels to move were successful in this case, and the patient made an uneventful recovery without further operative interference. If there had not been present the marked distention of the caecum operation would have been urged. If the gas collec-



FIG. 12.—Same case as Fig. 11 on day 12 of discharge. This cat illustrates the appearance of the normal abdomen when the roentgenogram is made under the conditions described in this article.

tions as above described are seen to occupy the middle of the abdominal shadow while the flanks are gas-free it is probable that the obstruction is in the lower ileum though not so low as the ileocaecal valve. When the gas areas occupy the true pelvis and the middle of the abdominal shadow, one may suspect the ileocaecal region. Intussusception may be recognized by colonic injection with an opaque enema. In doubtful cases the opaque enema may add to the information to be obtained from the X-ray study without embarrassment to the patient.

If the observation of the gas-filled bowel (without the ingestion of barium) does not make clear the approximate location of the obstruction, time will be saved by proceeding at once with the barium enema to rule out colonic obstruction. If the entire colon fills, it is then recognized that the obstruction must exist in the small bowel. If the findings up to the moment are still indecisive and doubt as to the need of operation still exists, a small amount of barium sulphate, say half an ounce, may be administered by mouth in any medium which the patient will swallow. These cases are often so doubtful from the

clinical standpoint that final decision as to operation is postponed for a few hours in any case, and there is thus ample time for some of the barium to pass on into the small intestine. After a little experience, however, it is quite unnecessary to administer any barium at all by mouth, the decision being rendered on the appearance of the abdominal shadow with reference to the character and distribution of the gas areas which may be present. If non-surgical treatment still seems indicated, the progress of the case under treatment may be watched by occasional films made to determine the progress of the small amount of barium which was admin-



FIG. 13.—Case of ileus associated with peritonitis. By experience one comes to recognize that this type of hindrance is characterized by gas distention both in the colon and in the small intestine and in spite of it partial success attends efforts to empty the bowel.

istered, or which may now be administered without fear. Nevertheless, emphasis is laid on the fact that it is not necessary to administer barium or any other opaque material in pursuing these studies, for in the great majority of cases even the subsequent observations may be made on the gas appearances. There is therefore no delay incurred, and no objection can be raised to the X-ray study of these patients on account of possible danger through delay or through the introduction of new food or foreign material into the digestive tract in the presence of possible obstruction.

It must be admitted that the employment of the above technic without the use of barium sulphate does not routinely give satisfactory data unless the case

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is immediately post-operative. This is possibly due to the fact that in nearly all post-operative cases, the bowel is practically empty, whereas in the other classes of acute intestinal obstruction, the intestine is often loaded with food residues. Nevertheless, when used in conjunction with an opaque meal or enema or both in appropriate cases, the X-ray method gives decisive information in any class of intestinal stoppage.

The writer wishes to again emphasize the statement previously made in this article that the suggestion of this X-ray method for establishing a diagnosis of ileus is not intended to in any way serve as a substitute for the other clinical methods already in general use, but this X-ray examination, carrying with it so little disturbance to the patient, requiring no preparation, and often giving such important help, is suggested as just one more means of diagnosis in the hope of reaching more quickly a definite decision. Needless to say this report is based upon a very extensive post-operative X-ray study covering several hundred patients, the great majority of whom had no untoward symptoms during their post-operative course, the examination being made to establish the normal post-operative behavior of the bowel and to serve as a basis for the conclusions above expressed concerning the value of the X-ray study in the early diagnosis of post-operative ileus.

SOME SURGICAL RELATIONS OF CHOLECYSTITIS *

By JOHN B. DEAVER, M.D.

OF PHILADELPHIA, PA.

THE function of the gall-bladder is still a matter of controversy, however evidence goes to show that individuals get along quite well without it so that we do not as yet definitely know how essential a part of the human body it is. But I often wonder whether one of the functions of this interesting organ is not that of forming a fruitful source of discussion among the profession. The inordinate amount that is being written and spoken about disease of the gall-bladder and the extensive investigations concerning its pathology, bid fair to exceed those which hitherto attached to the appendix and to peptic ulcer. In this widespread discussion it is well to remember that disease of one organ rarely fails to affect neighboring organs, thus illustrating the old adage that evil associations corrupt good manners.

This applies with exceptional force to the upper right abdominal quadrant. Here within an area easily covered by the palm of a man's hand we find the antrum of the stomach, the duodenum, the gall-bladder and bile passages, the head of the pancreas, the right kidney, the ascending portion and hepatic flexure of the colon, and finally a little further down the ubiquitous appendix. If, in addition to this anatomic relationship, we consider the more or less common nerve supply to these organs and the more or less free lymphatic communication between them, we have an explanation for the striking tendency to associated disease in this interesting quadrant of the abdomen.

As in nearly all non-neoplastic diseases of the upper right abdomen, the fundamental cause of disease of the gall-bladder is infection, and whether this takes place by an ascending or a descending route or a hæmatogenous or a lymphogenous route, it is the cause of the inflammation which leads to disease of the gall-bladder. The rôle the liver plays as the original distributor of this infection is a paramount one in present-day discussions of this subject. Bacteria are doubtless carried to the liver through the portal circulation, in the same manner as bacteria are continually passing through the kidney, and failing to be completely destroyed by the action of the liver are secreted in attenuated form, probably in the bile, as it enters the gall-bladder. And if Sweet's recently expounded theory that what enters the gall-bladder does not come out is correct, we have an easy explanation of some infections of the gall-bladder and the biliary tract.

But leaving aside this attractive theory, from a practical viewpoint we are aware of one or two important facts, namely, that owing to the interrelationship of the entire biliary system it is not difficult to suppose that infection within its confines necessarily affects its component parts, and secondly, that

* Read before the Post-graduate School, University of Pennsylvania February 8, 1924.

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in view of this we must expect more or less wide variations in the clinical picture of cholecystitis. The picture is of course influenced by the extent of the lesions and the presence or absence of stone formation. Clinically, nearly every cholecystitis is a cholelithiasis. In the Lankenau Clinic we find that only about 18 per cent of the cases of cholecystitis are not associated with gall-stones. The clinical differentiation between a calculous and non-calculous cholecystitis is not always possible, for at least 70 per cent of the latter give a history of attacks of pain resembling gall-stone colic and about 35 per cent a history of jaundice. X-ray diagnosis is not always reliable in view of the fact that not every type of gall-stone is demonstrable by X-ray although it may confirm the clinical suspicion of the presence of gall-bladder pathology. Another circumstance that must be borne in mind is that it is not the presence of the stones so much as the complications and pathology they may cause that demands the surgical treatment of cholecystitis. The theory of innocent gall-stones has long ago been proven a myth by W. J. Mayo and others. A careful history of the cases which claim never to have had any symptoms of gall-bladder trouble will usually reveal some indication of the disorder at a more or less remote period before coming to operation.

Clinically also, nearly every cholecystitis is associated with hepatitis and oftentimes with pancreatitis, although the degree of involvement may be so slight as not to be diagnosable, clinically. Pathologically, however, the liver as I have frequently observed, so often does show such pronounced evidence of disease that one naturally is led to believe that a primary infection of this organ has extended to the gall-bladder, and in turn from the gall-bladder to the pancreas. That infected bile is the germ carrier and the lymphatic the route it pursues is now being more generally recognized than formerly. Personally I have adhered to this theory for a long time. The sequence of events from a slight hepatitis to a pancreatic lymphangitis and chronic pancreatitis associated with a diseased gall-bladder is demonstrable almost daily in my clinics. Archibald claims that the inflammation in the pancreas may be due to the influx of bile into the pancreatic ducts, but experimental work by Mann and others has shown that this does not occur except under exceptional circumstances such as violent retching, vomiting, etc. In other words the irritation comes from the lymphatics, the irritation causes stasis of infected bile and the stasis sets up the vicious circle between the liver, gall-bladder, pancreas and bile ducts.

The bearing of this on the surgery of the gall-bladder is readily seen in that neither the liver nor the pancreas have as yet permitted any direct surgical assault, and it is mainly through the gall-bladder that their disorders can be attacked.

Although with the passing years familiarity with the operation of cholecystectomy has removed the technical disadvantages of the radical compared with the conservative operation nevertheless the discussion of cholecystectomy versus cholecystostomy goes merrily on in fact seems to be undergoing some-

what of a revival at this time. It is not so much the immediate mortality of the two operations that causes the discussion, for in the hands of the expert there is practically no difference between the two, except that perhaps cholecystostomy has a somewhat higher death-rate, due to the fact that most of the cases thus treated are more desperately ill than the ones subjected to cholecystectomy. The main question as to the relative merits of the two operations, to my mind, are the function of the gall-bladder and the end-results of the two methods.

That the function of the gall-bladder is not a very important one is readily seen from several facts. The diseased gall-bladder certainly does not functionate, nor does the retained cholecystostomized gall-bladder, bound down by post-operative adhesions, functionate, and furthermore, the majority of cholecystectomized individuals get along remarkably well without the organ. Cholecystostomy, when there are no contra-indications to the radical operation, is a conservative operation mainly because it conserves the gall-bladder for probable future trouble. This is evidenced from the reports from various sources of the end-results of the two operations. In my experience from four to eight per cent of the patients who have been operated for disease of the bile passages return for re-operation for symptoms of recurrence of the disease, and that of these about 80 per cent have returned after a primary cholecystostomy. On the other hand, if the future trouble takes the form of common duct obstruction or of chronic pancreatitis, the retained gall-bladder may prove useful for making a cholecystoduodenostomy, the indicated procedure in such cases. But the question arises might not a primary cholecystectomy have prevented such sequelæ? The most common cause of recurrence after drainage of the gall-bladder is gall-stones, which have either persisted or have re-formed. Of course, it is not easy to determine whether the stones were overlooked at the first operation, but the impression is strong that they have re-formed, since many of the cases present so large a number of stones that it is scarcely probable that they could have been overlooked. Anyone familiar with gall-bladder surgery, however, knows how difficult it is to clear the two primary branches of the hepatic duct, and how readily it may happen that in attempting to do so, one or more stones may be pushed upward beyond reach and later cause common duct obstruction, for obstruction of the common duct is the most frequent finding in these re-operated cases. It is a well-established fact that in prolonged cases of symptoms of cholecystitis, the bile ducts become dilated and stones are apt to lodge in the recesses, so that they cannot always be detected or always removed at operation, and thus persisting, cause the recurrence of gall-stone symptoms. The best prophylactic for this is, of course, early operation before dilatation and irregularity in the lumen of the ducts have had a chance to develop.

The most frequent cause of recurrence after cholecystectomy is adhesions, and the most serious in my experience of re-operated cases is persistent chronic infection, involving the pancreas.

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Adhesions cannot always be prevented even with the most careful technic, and must be accepted as a post-operative possibility. We cannot, however, so easily resign ourselves to the acceptance of chronic pancreatitis as a sequel to cholecystectomy. The condition is usually a pre-operative one and can be avoided in most instances by early attention to symptoms of gall-bladder pathology. Once established, chronic pancreatitis does not always yield promptly to treatment in these recurrent cases, in the absence of the gall-bladder, drainage through the common duct affords relief and often cure, but the outlook for a permanent cure is not altogether encouraging.

AMŒBIC LIVER ABSCESS

WITH A REPORT OF TWO CASES OCCURRING IN CONNECTICUT

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AND

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Introduction The occurrence of amœbic abscess of the liver in two patients, in conjunction with a small local epidemic of nine cases of amœbic dysentery in Connecticut, has brought to our attention a subject which has hitherto received but little consideration in countries not infected with tropical diseases. The clinical diagnosis and the treatment of this disease, as well as the climatology and pathology, have been most completely covered by Sir Leonard Rogers¹ in his Lettsonian Lectures in which he based his conclusions on many cases, under observation for a long time, in that excellent clinic for tropical diseases, India. Ludlow,² Mebane³ and Hartmann-Keppel,⁴ have also reported fairly large series from tropical and semi-tropical countries, but the present epidemic, as far as can be determined, is the first to be reported from Connecticut. The two cases of amœbic abscess of the liver herein detailed are therefore presented in order to call attention to the importance, even in regions supposedly free from amœbic disease, of considering the diagnosis of amœbic abscess of the liver in patients with obscure infection in the upper abdomen. In addition the marked advantages of the treatment outlined by Rogers,¹ as compared with the methods which have been hitherto employed will also be pointed out.

Local Epidemic—The small epidemic of amœbic disease which occurred in Connecticut consisting of nine cases, was localized within a suburb a short distance from New Haven, and has been completely reported by Blake.⁵ Seven of the patients presented typical cases of amœbic dysentery, none of whom developed liver complications. The source of the infection was well localized by the Connecticut State Department of Health, and there has been no further spread of the disease. The two patients who were suffering from amœbic abscess of the liver did not give any previous history of intestinal disease but were admitted to the New Haven Hospital with the symptoms of a subacute infection in the upper abdomen. Our report will therefore consider these two patients, and will discuss the surgical diagnosis, and treatment of this complication of amœbic dysentery.

Diagnosis In general the diagnosis of an unusual condition such as amœbic disease of the liver, receives from the profession a degree of consideration commensurate with the frequency with which it occurs in that particular geographical area. Thus, whereas solitary liver abscess should be considered first, in the differential diagnosis, if the patient were living in

India, Korea, or Panama, it is the condition suspected last, if at all in temperate zones, where tropical diseases are an extremely rare occurrence. One has to depend, therefore, on all the factors generally available in establishing the diagnosis of any given condition, and these, together with the knowledge that uncommon diseases though rare, do occur should be of considerable assistance in arriving at a correct clinical diagnosis.

The history of patients suffering from amoebic disease of the liver is one of a long-standing, debilitating infection, with or without chills, and most frequently accompanied by a diurnal elevation of temperature and marked diaphoresis. There is anorexia, loss of weight and asthenia, marked pallor, and rarely definite jaundice. The past history does not necessarily include attacks of dysentery, and from this point of view may be misleading. The physical examination demonstrates the points indicated by the history. The patient appears septic, and has definite dulness and tenderness over the liver region, in front and posteriorly, with a limitation of respiratory movements in some cases. There is a downward extension of the normal liver dulness for a variable



FIG. 1.—Case I. Plate of chest before operation showing high fixed diaphragm.

distance below the costal margin, but the rigidity of the abdominal wall makes actual palpation of the liver difficult. The laboratory examination is not consistently of assistance in establishing the diagnosis. The urine has no special significance in the disease. The stools may or may not contain cysts or amoebae, so that the absence of this microscopic evidence upon examination of the faeces does not preclude a diagnosis of amoebic dysentery, neither does it rule out any of the complications of amoebiasis. The blood examination is not consistently indicative of the presence or absence of amoebic infection, the white cell counts varying from the normal up to 30,000. In the presence of a leukocytosis there is generally also an increase in the polymorphonuclear cells, but with no pronounced eosinophilia. Radiography can be of considerable assistance, and,

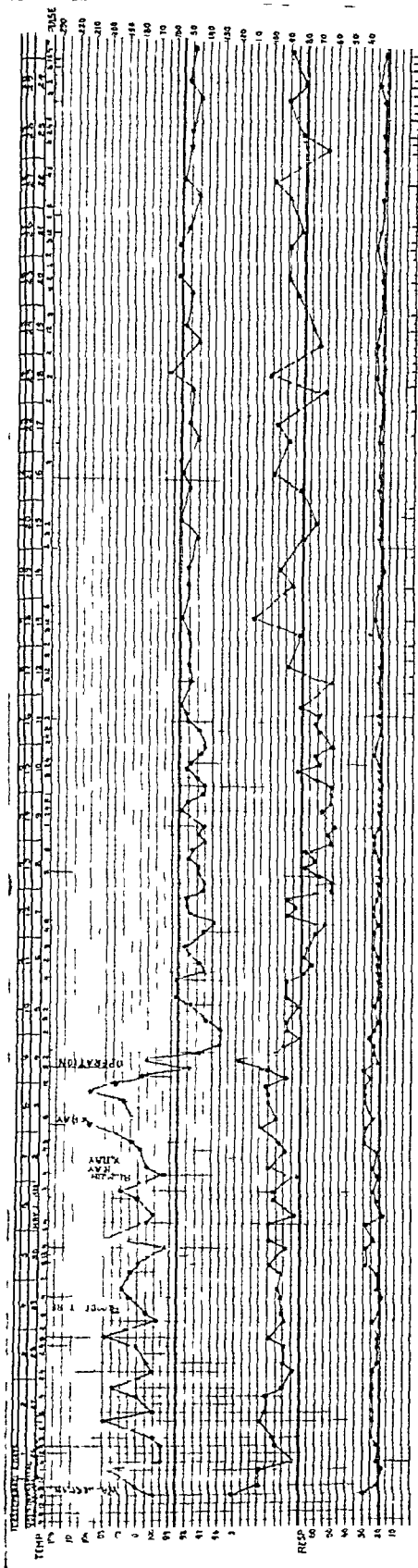


FIG 2 —Case I Chart of vital signs, showing striking temperature reaction following aspiration of abscess

in the presence of a well-established liver abscess, demonstrates a fixed, elevated diaphragm with the preservation of the costo-hepatic angle (Figs 1 and 3)

Exploratory puncture of the liver is advocated by workers in areas infected with amœbic disease, and this procedure, in many instances frequently determines the diagnosis. The prevalence of amœbic disease in the tropics makes hepatic puncture a procedure as frequently employed as thoracentesis. Diagnostic liver puncture cannot, however, be advocated as a freely applicable measure in countries where the disease is rare, because of the dangers involved. Rogers¹ quoted Hatch as having reported six fatal cases of intraperitoneal hemorrhage following such puncture, in which no abscess was found post-mortem, the livers were in the pre-suppurative stage of hepatitis, and the disease could have been cured medicinally. Such results should tend to discourage a diagnostic puncture of the liver, and where this disease is uncommon it would be preferable to make a small exploratory incision, particularly in the absence of a definitely established diagnosis. With open exploration the character of the disease in the upper abdomen can be established with safety, and the liver can then be punctured and aspirated, either at the same time, or at a later period, through an artificially established and well walled-off sinus. Such a procedure can be carried out with a minimum degree of shock to the patient, and certainly without the hazard of fatal intraperitoneal hemorrhage from the liver.

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Treatment The most important phase of the subject for consideration in this report is the method of treatment of amoebic liver abscess, as it is on this question that there is such a wide diversity of opinion

LUDROW² in reporting his one hundred cases, in which he advocated open incision and drainage for the treatment of amoebic liver abscess, made reference to the possibility of the conservative method of aspiration in conjunction with the use of emetine. However, he employed the aspirator for the diagnosis only, in sixty of his cases and the open incision and drainage of the abscess cavity in the liver for the actual treatment. Hartmann-Keppel,⁴ in twenty-two patients resorted to emetine treatment, with or without therapeutic aspiration, while in some instances he employed open incision and drainage of the liver substance. His conclusions placed great importance upon the role emetine played in the prevention, arrest and ultimate cure of amoebic liver abscess. He also emphasized the failure of surgery, namely incision and drainage, in the two patients in whom emetine was not employed. In addition he pointed out the importance of a guarded prognosis in reference to complete cure because of the frequency of recurrences even in the most carefully treated cases.

McBANE,³ in fifty cases reported from the Government Service in Panama, in which the mortality rate was "more than one-third," advocated the open treatment by tube-drainage and frequent irrigations. The mortality rate as in other series which have been reported, was more or less influenced by the condition of the patients at the time of operation, and those who were moribund would have died even under the most conservative method of treatment. McBane's statistics, however, are very similar to others in which the operation of incision and drainage of the liver substance was employed.

Rogers,¹ in a complete review of the problem from every point of view, arrived at the conclusion that incision and open drainage of amoebic liver abscess was incorrect in principle, and his argument becomes irrefutable when one considers the large amount of material which he studied. His conclusions were based on two principles:

1. As soon as the fibrous wall of the liver abscess is formed, the destruction of the liver tissue is halted. This quiescent state prevails, as long as there is not superimposed a secondary pyogenic infection in the abscess cavity. He established this point more clearly by comparing the relative innocuousness of an amoebic abscess of the liver containing eight pints of amoebic pus, with a small pyogenic abscess in the same liver, which followed the open operation and which caused the death of the patient from sepsis. Rogers¹ quoted Spencer, of the Royal Army Medical Corps, who stated that "the chief cause of the high mortality in this condition (liver abscess), is the secondary infection of the abscess cavity through the open wound," after the abscess has been incised and drained. In proof of this Rogers cited the fact that 86 per cent of cultures from the pus obtained in amoebic liver abscesses of the liver was sterile at the time of aspiration, and that the bacterial growth in the remaining 14 per cent was possibly due to incidental contamination, whereas the same patients, several days after the open operation were all harboring a secondary pyogenic infection in the previously uninfected abscess cavity.

2. The mortality of the aspiration method, as compared with that of the

open operation, was strikingly brought out in Table I of Rogers' report*. In this table, representing a series of two thousand six hundred and sixty-one cases, from seven institutions, the open operation was employed with a mortality of one thousand five hundred and eleven, or 56.8 per cent. On the other hand, in a series of one hundred and eleven cases, treated by aspiration, and medication with either ipecacuanha or emetine, there were sixteen deaths, or 14.4 per cent. It is interesting to note, that among the series treated by the aspiration and medication method, there were patients of Thurston and Chatterji, who had also contributed to the earlier series treated by the open drainage method. Thurston's groups represented forty-five cases with eighteen deaths by the open method, and forty-eight cases with eleven deaths by the conservative aspiration method, showing a decline in mortality from 40 per cent to 23.3 per cent, in parallel series, by the same worker.

These two related arguments can certainly point in only one direction, namely, that aspiration of the liver abscess cavity by the closed method obviates the danger of secondary pyogenic infection, and that the combined treatment by closed aspiration and emetine gives better results than the open operation of incision and drainage of the liver substance.

The development of the medicinal treatment of amœbic disease of the liver was very well summarized by Rogers, and he traced its evolution from early European practice in 1658, and its first use in India in 1660, down through the work of Abercrombie, Twining, Annesley, Maclean, Docker, Parkes, Chowers and Manson, beginning with the early empiricism, and going through the uses of ipecacuanha, antimony, ammonium chloride, quinine and finally the refined alkaloid of ipecacuanha, emetine.

The treatment advocated by Rogers, therefore, very definitely improved upon the more radical open method, and the results of this rationale appeared particularly applicable to the well-established case of solitary liver abscess of long standing. Our two cases strikingly illustrated the distinct advantages of the procedure, and in these patients, the exploratory exposure of the liver, previous to aspiration, was necessarily diagnostic as well as therapeutic, and appeared to be the safer method to employ in a climate where tropical diseases are rarely seen. Although in our second case the possibility of amœbic liver abscess was considered, it did not appear safe in either of the patients to perform a blind exploratory hepatic puncture, particularly in view of the degree of debility in which they came to us. In both cases, a single aspiration and a double course of hypodermatic injections of emetine, to be detailed later on, proved sufficient for a cure, and to date both of our patients have been free from any recurrence. Both exploratory incisions were performed under a light gas and oxygen anæsthesia, and although the procedure produced a minimum of operative shock, it obviated the danger of blind puncture and the consequent intraperitoneal hemorrhage. A detailed report of both cases follows.

* Table I A, p. 574

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CASE REPORTS

CASE I—H. N., male, age thirty-six, a laborer, born in Greece, was admitted to the medical service of the New Haven Hospital on April 25, 1922. At the time of admission the patient complained of pain in the right side.

History—The patient had been well until January, 1922, at which time he noticed that he tired easily and had marked loss of appetite. Toward the end of February, 1922, he began to suffer from a severe pain in the right upper quadrant of the abdomen. The pain was not lancinating in character, and did not radiate in any direction but was fairly constant. There was no jaundice, no nausea, no vomiting, no diarrhoea and no cough. There were no definite chills, but he had an afternoon temperature and profuse night sweats. His condition grew gradually worse, and at the time of admission to the hospital he was quite asthenic and had lost about twelve pounds in weight. There was no previous history of similar attacks of pain, jaundice or dysentery and no important urinary history. There was no history of lues, and the family history was also negative.

Physical Examination—The patient was a poorly nourished man with a sallow complexion but without jaundice, and he appeared quite definitely septic. There was no general glandular enlargement. The examination of the heart and lungs was essentially negative. On abdominal examination, the point of interest was the right upper quadrant. Here the liver dulness began at the fifth rib and extended downward to about 3 cm. below the costal margin, in the nipple line. The mass below the costal margin moved with inspiration but could not be definitely identified as the edge of the liver. The remainder of the abdomen was essentially negative. There were no other positive points in the physical examination.

Vital Signs—Temperature, 100° F., pulse, 120 per minute, respirations, 20 per minute.

Laboratory Examination—Red blood-cells 3,632,000, white blood-cells 8,600, with 75 per cent polymorphonuclears, 18 per cent lymphocytes, 7 per cent large mononuclears and no eosinophiles. Hemoglobin 60 per cent. The red cells showed a general achromia but there were no other positive findings in the blood. The urine and the stools were negative. Blood culture, Widal, and Wassermann were negative. X-ray examination showed a moderately elevated right diaphragm and an enlarged liver (Fig. 1).

The temperature continued to range between 100° and 103° F. with a corresponding fluctuation in the pulse and respirations, and on the eighth day after admission the patient was transferred to the surgical service and was operated upon on the following day.

Operative Note—After the usual skin preparation and under gas-oxygen anesthesia, the right upper quadrant of the abdomen was opened through a high split rectus incision. The anterior wall of the stomach presented in the incision and a fold of



FIG. 3—Case II. Plate of chest before operation showing diaphragm fixed and higher than in Case I.

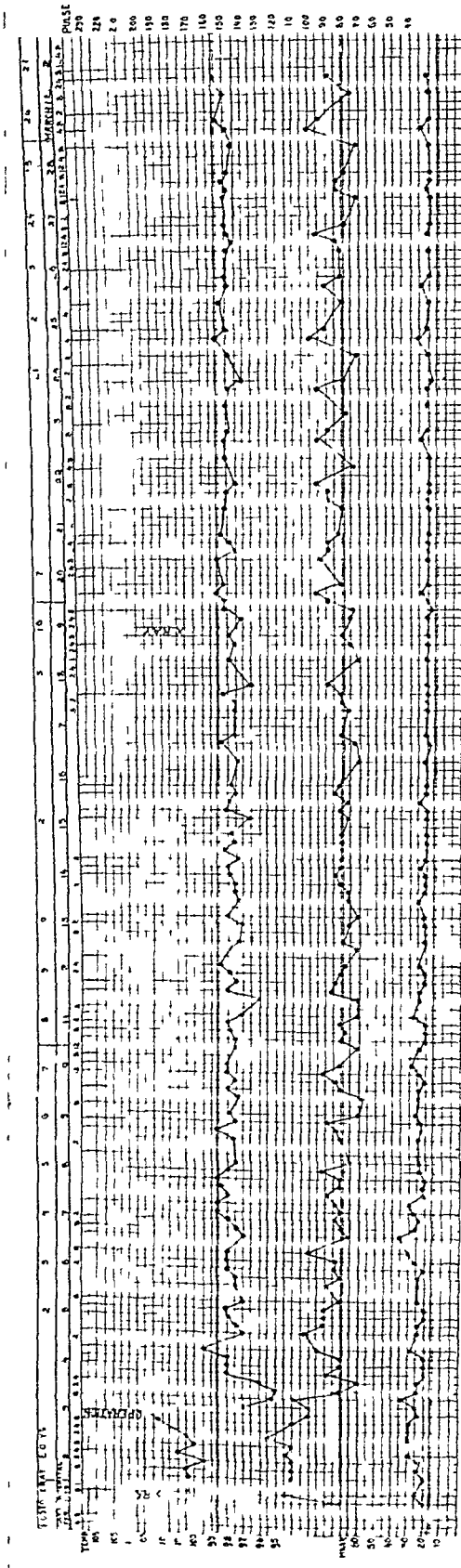


Fig 1—Case II Chart of vital signs, showing sharp drop in temperature and pulse, following evacuation of abscess

adhesions which extended from the pyloric end of the stomach toward the gall-bladder was divided. Exploration showed the stomach and first portion of the duodenum and the gall-bladder to be of normal appearance and consistency. The gall-bladder wall was not thickened and there were no stones palpable. The head of the pancreas was palpated through the foramen of Winslow, and nothing abnormal was found. The liver extended about four inches below the costal margin. The lower portion of the right lobe was of fairly normal consistency, but when the hand was passed up over the surface of the right lobe, a definite ring of induration was felt which was approximately twelve centimetres in diameter. The liver substance at the centre of the ring of induration felt rather boggy. A dull aspirating needle, on a twenty cc Luer syringe, was inserted into the soft portion at the centre of the ring of induration above described, and at a depth of about three or four centimetres beneath the surface of the liver, a thick, reddish chocolate-colored pus was obtained, which had a faint milky odor. About 1200 cc of this material was withdrawn and the needle was then removed. The abdominal wound was closed in layers, and its upper angle was packed with a strip of gauze which extended down to the liver surface at the site of aspiration. This packing was placed in order to establish a small, walled-off sinus tract down to the liver surface through which further aspiration might be carried out in case it should become necessary. The patient stood the operation very well, and was returned to the ward in good condition. Soon after being returned to the ward his temperature dropped from 101.5° to 96.2° (Fig 2). He received his first dose of emetine hydrochloride, gr ½ hypodermatically, at this time, and within about thirty hours his temperature became normal and fluctuated just below the normal line until his discharge from the hospital, twenty-one days after operation. The pulse curve also remained about the normal average throughout his convalescence. No further aspiration appeared necessary.

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Post-operative Course—The pus which was aspirated from the liver abscess showed no amœbæ or cysts. The stools were consistently negative for amœbæ, and the patient received one grain of emetine per day for seven days following operation. This course was followed by a period of rest of one week's duration and then a second course of emetine, one grain per day, totalling seven grains, was given. His symptoms entirely disappeared, his general condition improved and when discharged from the hospital he was definitely gaining in strength. He reported back to the out-patient department several times during the following month, at the end of which period his general condition was excellent. He was requested to return to the hospital for re-examination and appeared on April 27, 1923. At this time, about eleven months after the operation he had gained twenty pounds and had been perfectly well during the entire period. The physical examination showed the liver dulness to be within normal limits with the lower border of the area of liver dulness at the costal margin and the edge not palpable. Examination of the stools at this time was also negative for amœbæ.

CASE II—M. C., female, age thirty-five, a housewife, born in Italy, was admitted to the surgical service of the New Haven Hospital on February 1, 1923. The chief complaint on admission was that of pain in the right side of the upper abdomen.

History—The patient's illness dated back for about eleven months, to March 1922. At that time she had had an attack of pain in the right upper quadrant of the abdomen, which was accompanied by general weakness and gastric distress, including nausea, vomiting, and pyrosis. There was no other intestinal disturbance and the bowels were perfectly regular, with the stools showing nothing remarkable. There was no jaundice, and at the time of onset of the illness the pain did not radiate. This condition continued for about six months, and in September, 1922, the patient had an exploratory laparotomy performed in another hospital. The operative findings, as far as they could be ascertained, were negative, and the gall-bladder, appearing normal, was not disturbed. The appendix, which was bound down by adhesions, was removed. The post-operative course appeared to be uneventful, but the symptoms, of which the patient originally complained, persisted. At this time, the pain began to involve the axillary portion of the right chest and also radiated to the right shoulder. The malaise and weakness increased, and the patient began to have a daily elevation of temperature, with night sweats. The nausea and vomiting continued and at the time of admission the patient had lost about twenty-five pounds. The past history showed nothing important, except that there was no history of any intestinal disturbance, simulating dysentery, at any time within the patient's memory.

Physical Examination—The patient was a poorly nourished, desiccated woman who appeared quite septic. She complained of severe pain in the right upper quadrant and the lower right chest. There was no jaundice, the heart was negative, the left chest was also negative. There was marked tenderness in the right upper quadrant, anteriorly and posteriorly, which began at the eleventh rib in the posterior axillary line and extended downward to the level of the umbilicus. The lower portion of the right chest was dull to percussion, and the breath sounds were suppressed from the fourth rib downward in front and in the axillary region. The area of dulness continued downward to about the level of the umbilicus and appeared to be due to the displacement or extension of the liver downward. The entire region described was tender to palpation, but there was an area of extreme tenderness in the right costovertebral angle. Otherwise the abdomen was negative.

Vital Signs—Temperature 100° F., pulse, 110 per minute, respiration 20 per minute.

Laboratory Examination—Red blood-cells 4,400,000, white blood-cells 10,920, with 64 per cent polymorphonuclears, 32 per cent lymphocytes, 4 per cent large mononuclears and no eosinophiles. Hemoglobin 60 per cent. The urine was negative, the stools were not examined.

X-ray Examination—The lungs were clear, but the right diaphragm was at the third interspace, dome-shaped, with marked fixation (Fig. 3). Within the next three weeks

hours the temperature rose to 103° , with a corresponding elevation in the pulse and respirations. An exploratory operation of the right upper abdomen was then decided upon, with a tentative diagnosis of subphrenic abscess.

Operative Note—After the usual skin preparation, and under gas-oxygen anaesthesia, a right sub-costal incision was made, parallel to the eleventh costal margin and continued down through the peritoneum. A small amount of clear straw-colored fluid presented, which had no odor, and was apparently simple transudate. Careful digital palpation through the peritoneal opening showed that the edge of the liver was adherent to the parietal peritoneum in every direction examined by the exploring finger, so that the general peritoneal cavity was completely walled off. The liver was the only intraperitoneal organ present, and the gall-bladder and colon lay below the line of adhesion. Laterally, the kidney was palpable and it did not seem to lie abnormally. Digital exploration upward showed the lower margin of the liver to be free and soft for about two and a half finger's breadth, but from this point upward, toward the dome of the liver, the entire organ was very hard, with the area of induration definitely localized and outlined. A dull aspirating needle was introduced into this indurated area, and after penetrating about four cm of hard liver substance, a thick, reddish-brown fluid was obtained, and of this about 400 c.c. was aspirated. The fluid had a faint milky odor and was homogeneous in consistency. The aspirating needle was withdrawn, and a wide strip of gauze tenting was placed in the posterior angle of the wound, down to the point of aspiration along the anterior surface of the liver, in order to establish a walled-off route for further aspiration, should any become necessary. An additional stab wound was made in the ninth intercostal space in the anterior axillary line, and this was also packed with gauze down to the surface of the liver, in order to obtain a more direct route for aspiration for future use. There was no operative shock, the remainder of the wound was closed in layers, and the patient was returned to the ward in good condition. Immediately upon being returned to the ward her temperature dropped from a pre-operative 103° to 99.5° (Fig. 4). She was kept warm, and within about twelve hours the temperature gradually rose to normal.

Post-operative Course—The wound healed *per primam*. *Amoeba histolytica* was identified in the stools on February 4 and 5, but repeated examinations thereafter up to March 2, 1923, the day of discharge, showed no amoebæ in the stools. The patient received two courses of emetine hydrochloride, consisting of one gram per day for seven days, an interval of rest for one week, and a second course of seven days similar to the first one. The vital signs remained around normal throughout her convalescence, and she was discharged on March 3, forty-eight days after the operation, completely cured. The patient was reexamined on April 27, 1923, and at this time, somewhat less than three months since operation, she had gained about twelve pounds, was in excellent general condition, and had had no recurrence of symptoms. The chest examination was negative, the edge of the liver did not extend below the costal margin, and the stools were negative for amoebæ.

SUMMARY

1. Amoebic abscess of the liver is reported for the first time in Connecticut, coincident with a small epidemic of amoebic dysentery.

2. The definite diagnosis of solitary amoebic liver abscess was in both cases established by exploratory laparotomy and aspiration. In climates where tropical diseases are uncommon, this procedure is safer than a blind hepatic puncture.

3. Rogers' method of treatment by aspiration and systemic emetine medication is productive of better results than the open incision and drainage.

AMOEBIIC LIVER ABSCESS

method. In the latter procedure, failure is due to secondary pyogenic infection of the abscess cavity.

4. A striking drop of the temperature to subnormal immediately following the operation, was noted in both of the cases herein reported.

5. Neither of our patients required repeated aspiration and to date there has been no evidence of recurrence.

BIBLIOGRAPHY

¹ Rogers, Sir Leonard. On Amoebic Liver Abscess. The Lancet, London, 1922, vol. cli, No. 5141, p. 463.

Ludlow, A. I. Liver Abscess. Surg., Gyn. and Obs., March, 1923, vol. xxxvi, No. 3, p. 326.

² Mebane, Tom S. Diagnosis and Treatment of Amoebic Abscess of the Liver. Journal A. M. A., 1920, vol. lxxv, No. 23, p. 1566.

³ Hartmann-Keppel, G. L. Twenty-two Observations d'abcès amibicus du foie traités par l'émétine. Revue de Chirurgie, 1923, No. 2, p. 5.

⁴ Blake, F. G. Proc. Conn. State Med. Soc., New Haven, 1923.

TRANSVERSE INCISION AND DEPENDENT DRAINAGE IN APPENDICITIS*

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PROPOSED operations based on plausible theory, supported as they frequently are by a limited clinical experience have a definite place in surgical literature. Only too often when more extensively tried and found wanting, abandoned even by their authors, or supplanted by improvements, there is no one to expunge the record which remains with the possibility of a disadvantageous retrial. Conversely an inadequately described or misunderstood plan of real merit may be overlooked.

In November, 1905, in the *New York Medical Record*, in an article on "Transverse Incisions in Abdominal Operations" I proposed, after a brief trial, the removal of the appendix through a transverse incision across McBurney's point, the outer end being just above the anterior iliac spine.

In January, 1906, in the *ANNALS OF SURGERY*, Gwilym Davis of Philadelphia, described a transverse incision for appendicitis. In response to a reprint of my paper, which I sent him, he wrote, that in the mass of surgical literature he had overlooked my communication, but trusted that together in time we might teach the profession that this method had definite advantages.

It will be evident by reference to the original papers that neither Davis nor myself fully comprehended the possibilities of the plan. Shortly after the publication of Gwilym Davis' paper he gave up general surgery for orthopaedics, and in 1918, to the great loss of surgery and all that it means in the relief of human suffering, he was taken by an untimely death. My subsequent paper before the Surgical Section of the American Medical Association in 1915, was without illustration. If apology is due for again calling attention to this procedure in the light of a continued and larger experience, it would be that the incompleteness of previous presentations has left an unfulfilled duty.

Although the external picture of the transverse incision does not readily appeal to the surgical imagination, if the operator will examine critically salient points of the surgical anatomy, he will be encouraged to venture on a method that I have never known anyone to abandon after it had been understandingly practiced (Fig 1). The oblique and transverse abdominal muscles have broad aponeuroses, the latter uniting and blending at the outer border of the sheath of the rectus, spreading over it anteriorly, and to a more limited extent posteriorly. The aponeurosis of the external oblique is the longest of the three. At the line of incision the fibres of the transversalis and internal oblique muscles are directly transverse, and the internal oblique, though vary-

* Read before the North Pacific Surgical Association, December 8, 1923

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ing a few degrees is further cut, and so soft that the variation is of no consequence in operation. After the transverse incision is carried through the skin to the deep fascia directly across McBurney's point the inner end should be over the belly of the rectus and the outer just above the iliac spine in the flank (Fig 1). The length of the incision will, of course, vary with the requirements of the case. The only part then cut is the rectus sheath, the aponeurotic junction at its outer border, and the aponeuroses of the muscles. The incision is then spread wide open by an up-and-down pull, like opening the drawing of a purse separating the muscle fibres, and exposing a surprisingly large area of peritoneum (Fig 2c).

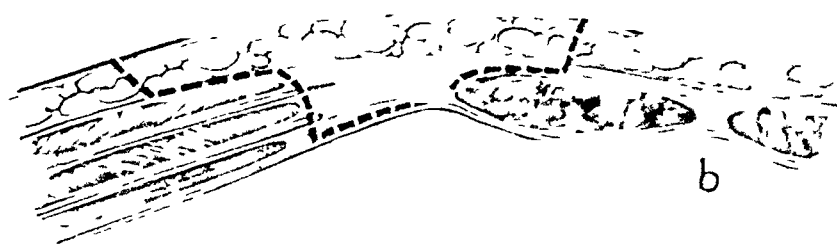
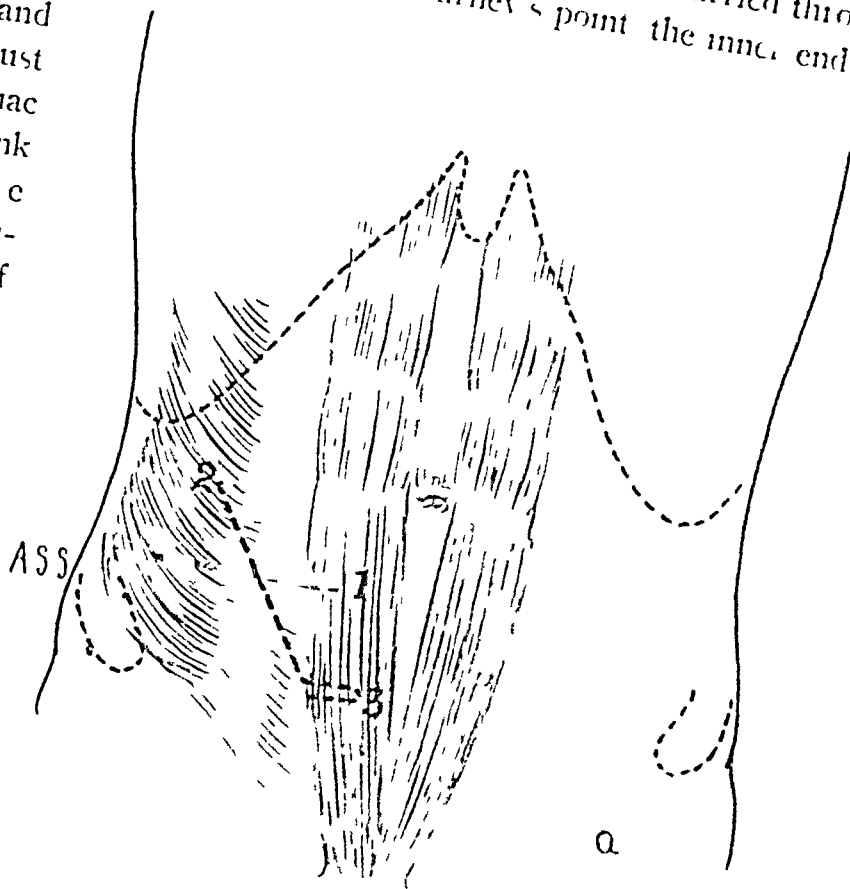


FIG 1—c. S. Fig 1 a 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

The up-and-down pull to open the incision is of major importance in the performance of this operation. The actual cutting is confined entirely to the fascia of the rectus and the aponeuroses of the muscles. This is the key which prepares for the opening which is made by the vertical pull. It is difficult to illustrate this. If I could protect a mental picture of it on the screen of surgical comprehension the percentage of transverse incisions especially in this operation would rise near the top instead of remaining so long near the bottom.

There is very little bleeding and nerves are not severed. Retractors are then placed at the inner and outer ends of the incision, drawing the rectus well into its sheath, and unifying the obliquity of the soft muscles at the

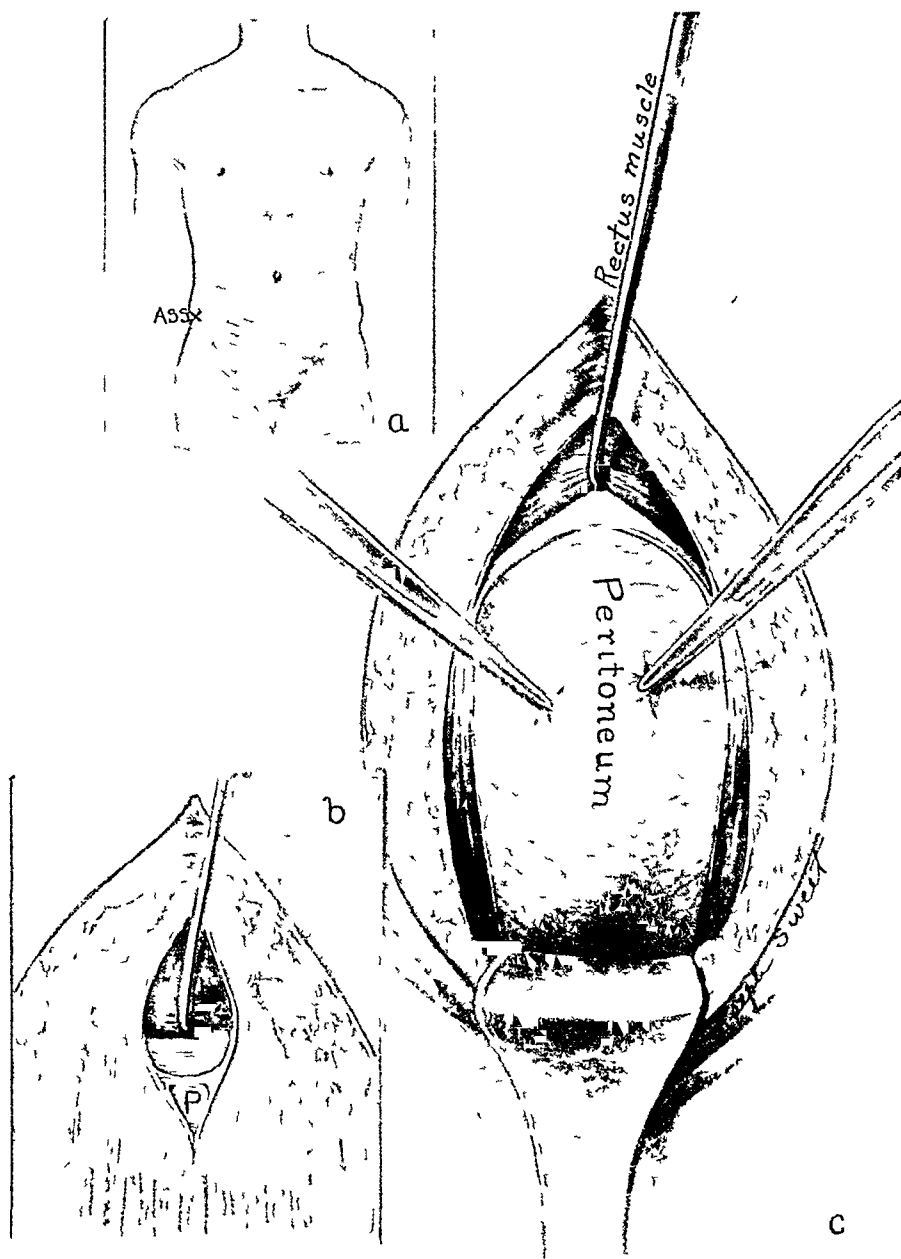


FIG 2—*a* Surface location of the incision *b* The key at the inner border of the rectus *c* The peritoneal exposure

outer side. This opening may be made in about half the time required for any other incision. The only part cut with the knife is that above the dotted line in Fig 1b. The resulting peritoneal exposure is illustrated in Fig 2c. For the necessity of anatomical clarity the inner retractor is represented by a hook in the illustration. The peritoneum is now incised on the same line, and if desired the retractors may be introduced within the

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cavity This should be done with caution not to overexpose the viscera particularly at the inner end When this is observed as it should be in purulent cases, the small intestine is seldom seen in the operative field Retrocæcal and extreme lateral position of the appendix furnish a large proportion of suppurative cases This may be for the reason that in this position the appendix has failed to follow the cæcum in that complete rotation that constitutes normal position It is consequently more likely to be abnormal in shape, and to offer obstruction to escape of normal secretions or to fecal intrusion This in turn sets up an irritation that predisposes the appendix that is retrocæcal, or in lateral position, to inflammatory attack I have no statistics on this point available, but the recollection of my personal experience would lead me to believe that this is true

In almost all others except the extreme pelvic (2 or 3 per cent), the appendix after detachment of adhesions can be lifted into the open incision by the finger without exposing the small intestine (Fig 3) Pelvic position in an acute appendicitis can usually be diagnosed before operation In that position the vertical mid-rectus incision should be made

Diagnosis is as yet not entirely an exact science It may well be that the condition revealed through the transverse incision may make some other approach more suitable The time consumed, and the anatomical disturbance, have been minimal The incision may be either abandoned or enlarged, as the case requires By carrying the superficial part of the incision only to a desired extent through the fascia of the rectus toward the inner border, it may be extended either up or down, without violating the rules of good surgery in dividing nerves supplying the muscle

In the great proportion of cases there is no packing with sponges to wall off the unaffected cavity The higher outer approach is the most direct to the seat of trouble The centre of the incision is across McBurney's point, which continues as truly to indicate the average location of the base of the appendix as when it was marked by that master surgeon Whatever the direction of the tip may be, this is the centre of surgical action This being so the purse-string or ligature may be applied with ease to the protruding cæcum without bringing it forward from an infected to a clean field

The lower border of the mesentery extends from the midline of the body outward to the cæcum and appendix The small intestine is always at the inner side To locate the appendix, if it is not directly under the opened incision, insert the finger downward against the anterior wall of the cavity Pass it outward under the end of the cæcum and then backward against the posterior wall, and then bring it upward and forward, when it will curve under the free border of the mesentery, and locate or bring with it the cæcum and appendix (Fig 3)

Non-suppurative cases, or those where pus is still confined within the appendix, need give but little concern Recovery is usually uneventful with any type of operation In purulent cases the result may be different The term purulent must be taken to mean not only gross pus, but the flocculent,

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grumous, peritoneal exudate, commonly foul smelling that is seen in the early stage of the more acute gangrenous appendices. There is greater need for dependent drainage of a septic fluid of this sort than there is for gross pus. Such fluid may precede the protective distention and adhesion of milder types, and for the first twelve hours dependent drainage is of the highest importance.

Drainage that is really dependent must be from the bottom of the cavity. Capillary drainage may come from any point within the range of capillary attraction. Drainage by point of least resistance will come when other avenues of escape are relatively obstructed. This is what takes place when a confined collection of pus is opened during the performance of an operation. All three of these factors enter into the mechanics of abdominal drainage.

The type of drainage varies with the changing conditions incident to disease and repair by healing. When a cigarette drain is inserted into a pus cavity, it is immediately active by capillarity. The efficiency of the capillarity begins to diminish from the first moment. This is due to the blocking of the meshes of the gauze by the corpuscular elements, and by the coagulation of fibrin. This short period of capillary drainage is often of great value. It permits intestinal distention and temporary adhesion to block the way to inward spread of infection, and drainage then takes place around the outside of the obstructed cigarette, which then becomes the point of least resistance. The cohesion of the smooth drain with the tissues offers less resistance than the temporary adhesion of the distended intestinal coils. To permit least resistance drainage to be efficient, the drain must be loose. The last stitch around the drain had often better be left untied. When now we have dependent position added to least resistance point drainage, we have the most efficient type, and the one that will so continue for the maximum time.

There are two periods incident to the surgery of suppurative appendicitis when dependent drainage is of vital importance. The first is during the performance of the operation. Take the very common location of an appendiceal suppuration at the outside of the cæcum. Let us visualize the operation just described. When the peritoneum is exposed as illustrated in Fig. 3, and then incised as indicated, taking great care to begin at the outer end, the confined pus may be liberated without any exposure of the unaffected cavity. When the point of least resistance is in the dependent part, the first important life-saving step of the operation has been accomplished. The operation may end here with drainage, but with a much greater degree of safety than by any other approach it may be completed by the removal of the appendix and dependent drainage. The purse-string suture should not be used in non-suppurative cases. The manipulation necessary to place the purse-string is an unwarranted extension of the infected field. The wall of the appendix is too inflamed. A simple ligature of chromic catgut will hold the appendix in place. We may then place cigarette drainage, bearing in mind the capillarity just described, or we may at once utilize the dependent position, as illustrated. The other period is when the capillarity



FIG. 4—The drain has been placed, the peritoneum closed loosely above it and the key sutures introduced ready to be tied

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ceases to be efficient, and it must come around the drain instead of through it. Here true dependency added to point of least resistance is an important factor of safety.

Efficient dependent drainage may be secured only by placing the patient in such position that the point of drainage is in the lowest part of the cavity. This may be obtained with the patient resting comfortably on the side and can be secured through the outer end of a transverse incision (Fig. 6). In pus cases requiring drainage the question of physical comfort may be exceedingly important in conserving the vitality of the patient. The transverse incision utilizes the same plan of opening the sheath of the rectus that had been previously proposed by Wier as an extension of McBurney's incision but at different levels, and requiring a different drainage position. The lines of these incisions and their relation to each other are shown in Fig. 1. In the ordinary semi-sitting position the entire basin of the pelvis and part of the flank, are below the lower end of the incision.

In a comprehensive paper on "Drainage in Appendicitis" by Elbert J. Rulison, Jr., of New York, in the *ANNALS OF SURGERY* for December, 1919, there is a critical analysis of 263 cases done at the Presbyterian Hospital that required intraperitoneal drainage. The types of incision used were McBurney's 176, Wier 43, right rectus 30, median 9, Rockey's 3, Kammerer 2, additional stab wound in flank for dependent drainage 10. We believe, however, that in the average general practice the vertical right rectus is more used than these statistics would indicate.

It will be observed in Rulison's table that a flank stab wound for dependent drainage was made in ten cases. This is just what the transverse incision provides in all cases. A stab wound in the flank will not, however, give complete dependent drainage if the patient is prone on the back. The posterior pelvic brim forms a barrier. Instead of the inefficient incomplete drainage in an uncomfortable elevated position the transverse incision provides efficient dependent drainage in a comfortable, lateral position that most persons assume in normal sleep. In this lateral position with the upper part of the trunk slightly raised, and comfortably supported on two or three pillows, there are two inclined planes sloping toward the flank: the abdominal downward from the diaphragm and the pelvic downward from the bottom of the pelvic basin meeting the upper plane at the outer end in the flank, which is then the lowest point in the abdominal cavity with the patient in the most comfortable position (Figs. 6 and 7). If drainage from the region of the diaphragm seems more indicated, the head of the bed may be raised on six-inch blocks without overcoming the downward drainage from the side of the pelvis.

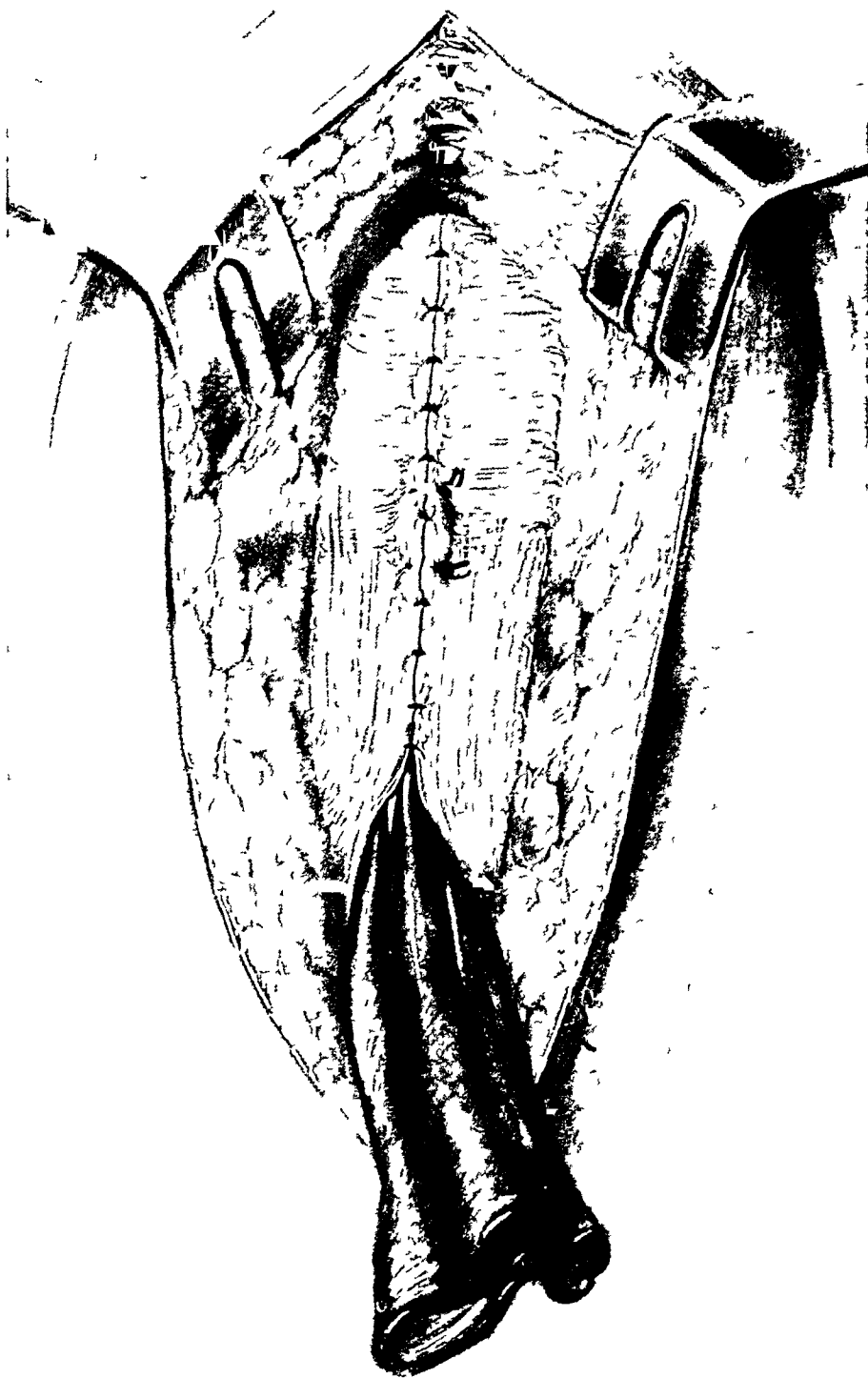
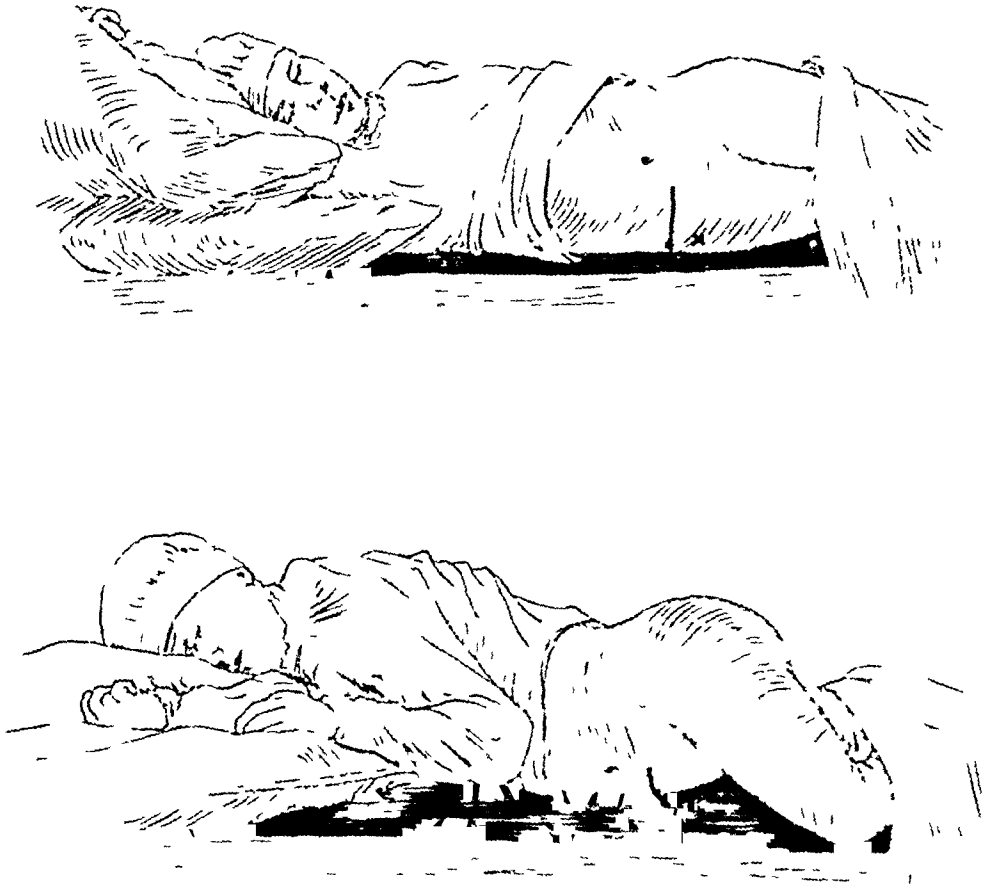


FIG. 5 —Key sutures tied Fascia closed

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be tilted through an arc of 40° and the right flank will still be the lowest point in the cavity. The vital time for complete dependent drainage is immediately after operation. After one to several days when distention first and adhesions later have limited the spread of septic fluids the position of the patient may be advantageously varied as illustrated in Figs. 6 and 7.

At this stage caution should be observed not to begin too early with efforts



FIGS. 6 and 7—The lateral position for dependent drainage should be varied for comfort.

to stimulate peristalsis. It is best to endure for a while the discomfort of tympanitis with its advantageous blocking of the uninfected peritoneal surfaces, and the production of autogenous antibodies.

the outer end through a short piece of Dakin tube in the standard way, but leave them untied until the caustic virulence of the sepsis has subsided. Hernia is very rare after operation by this method, and then only where the virulence of the infection has caused sloughing of the fascia. When it does occur, a sufficient time for the subsidence of residual infection should be allowed to elapse before any attempt is made to repair it.

I bespeak for this method of incision and dependent drainage a trial in the worst of suppurative cases. Its superiority in these will soon demonstrate its special fitness for the majority of others, until its general use will become a routine, as it has with me for more than eighteen years.

RECURRING HERNIA OF THE DIAPHRAGM*

By PHILEMON E. TRUFSDALL, M.D.,

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THREE operations upon the same individual for traumatic hernia of the diaphragm within a period of three years have provided rare opportunities for observation. The subject of this series of mishaps, a boy of five years, was run over by an automobile on May 11, 1920. One wheel of a touring car passed over his upper abdomen producing a rupture of the diaphragm on the left side. The condition was not discovered until January 24, 1921. To relieve obstruction of the intestine we operated by the transthoracic approach on February 23, 1921. This case with one other of similar origin in a child of three and one-half years I reported before this society in June, 1921. Doctor O'Connell, of Providence, R. I., reports the condition of his case the younger child, as well after three years.

The older boy developed acute intestinal obstruction on November 30, 1921, nine months after the first operation. Laparotomy revealed a greatly distended colon from the ileocecal valve to a point in the transverse colon which had become fixed in the vicinity of the original tear in the diaphragm. Cecostomy was done and no effort was made to reduce the obstruction. X-ray examination then demonstrated an obstruction in the transverse colon. He left the hospital December 11, at which time his bowel movements had become normal. Five weeks later he was readmitted for incomplete intestinal obstruction, the cecostomy acting intermittently as a safety valve. The X-ray examination again showed the barium column intercented in the transverse colon at a

We had good reports concerning the patient's condition until November 30, 1922, ten months after the second operation, when he was admitted again because of abdominal pain and persistent vomiting. While coasting during the previous afternoon he had taken a "belly bumper" whereupon he was seized with cramps and distress in the abdomen. Upon examination there was definite evidence of peristalsis in the left chest as high as the angle of the scapula. The cæcostomy opening had entirely closed. Recurrence of the hernia through the diaphragm was therefore obvious. As a preliminary step the opening into the cæcum was reestablished for immediate relief. Five days later, on December 5, the diaphragm was approached by laparotomy. The transverse colon was found to have passed through the diaphragm at the site of the original tear and held by adhesions about the opening. The patient was in good condition. We had become familiar with his measure of endurance, hence we felt that examination of the diaphragm similar to that made at a previous operation could be carried out with more accurate determinations. Therefore, we walled off the stomach, spleen and bowel, and drew the diaphragm well down into the operative field. An examination of this entire leaf was made as thoroughly as a reasonable time would permit. The edge of the left lobe of the liver had entered the hernial opening. Having become fixed in this position it was separated and withdrawn with some difficulty. This was sufficient to free the colon, a long loop of which was then drawn down through the opening into the abdominal cavity.

Examination of the diaphragm at the aperture revealed a thick cicatrix forming the inner edge of the ellipse with substantial body to the diaphragm adjacent, while the outer edge of the ellipse was thin and the middle portion of the diaphragm perceptibly meagre. This would appear to indicate that trophic disturbances had followed injury to terminal branches of the phrenic nerve and warrant the supposition that, under sudden violent increased pressure within the abdomen rupture occurred by separation of the thin portion of the diaphragm from the margin of the old cicatrix. On this occasion the opening was closed by interrupted sutures of chromic catgut reinforced by a running stitch of silk. Electrical stimulation by the faradic current was applied to various portions of the diaphragm. An immediate sharp contraction showing normal nerve irritability was found along the course of the phrenic nerve, until it reached the cicatrix which ran almost transverse to the median branch. Further examination revealed not alone the perceptible thinning of the central portion of the diaphragm in this case but a sluggish response to the electric current over this area, indicative of degeneration in the terminal nerve fibres and motor end-plates in the muscle. Again as we approached the rim of the diaphragm contractility to stimuli was more pronounced but far less vigorous than over the unimpaired phrenic nerve. The abdomen was then closed and the patient made an uneventful recovery, leaving the hospital on the tenth day.

A review of the events in the above case provides material for a three-point discussion of the subject of recurring traumatic hernia of the diaphragm, dealing first with the cause of recurrence based upon a study of the position and nature of the tear in the diaphragm as well as alterations of its innervation and tonicity, secondly, with choice in methods of approaching the diaphragm in order to repair the damage in similar cases, and third, with the technic to be employed in effecting a reduction of the displaced viscera and closing the rupture.

It is probable that the line of division in rupture of the diaphragm from external violence more often follows than crosses the nerve fibres and vessels, yet it is conceivable that instantaneous rupture from violence may not parallel the nerves in the direction of the median or lateral lumbo-costal arches, but more probably intersects their course and results in injury to the terminal

branches of the phrenic, sufficient to produce trophic changes in the musculature of the diaphragm with at least a moderate degree of eventration as a consequence. May this not be true of the median branch in particular? The findings in the above case would appear to justify this assumption, especially in the light of recurrence of hernia on each occasion after a nine months' period of apparent security and the persistence of a perceptible eventration of the left side of the diaphragm. Incidentally, in this respect, traumatic hernia of the type here considered differs from congenital hernia, where, owing to a deficiency in the diaphragm itself the terminal branches of the phrenic nerve remain intact but are merely diverted from their normal relation to each other.

In order to study the effects of disturbed innervation of the diaphragm and its application in the case reported above, Dr. Walter Cannon granted me the privilege of conducting a series of experiments with the cooperation of Dr. Alexander Forbes in the department of Physiology of the Harvard Medical School. The first experiment consisted in producing an opening 10 cm. long in the diaphragm of a dog under morphine and ether anaesthesia. The line selected was about 5 cm. to the left of the oesophageal opening and in an oblique antero-posterior direction. The result of this opening was a definite cuppling of the diaphragm. Single make and break shocks produced a sharp reaction over the area of the median side of the artificial opening while the same test resulted in a less vigorous response over the nerve fibres on the outer side of the tear and a perceptible slowing down of the response of the musculature in the anterior and central part of the diaphragm. The second experiment was carried out upon the diaphragm of a cat, in which one year ago the upper root of the right phrenic nerve had been cut. By laparotomy both sides of the diaphragm were explored with stimulating electrodes. By using single break shocks the contractions in response to stimuli appeared to be normal or nearly so over the entire diaphragm. The abdomen was then closed and a dissection of the left side of the neck was made. Both roots of the left phrenic nerve were cut. The wound was closed. Ten days later the diaphragm was again exposed by laparotomy. Spontaneous contraction was seen in the right diaphragm, none in the left. Left side was visibly flabby as compared with the right and showed a tendency to rise when the right diaphragm contracted, a phenomenon which no doubt would be greatly increased with the abdomen closed. At first, exploration with the stimulating electrodes by using single make and break shocks seemed to show a brisk response in the central part of the right leaf and only small twitches in the same part of the left. Later the central part of the left side showed fairly good contraction, but nowhere comparable to the response obtained on the right diaphragm. In the ventral area, there was much less contraction on the left side than on the right. About the rim of the diaphragm there was good contractions on both sides.

The observations indicate a distinct nerve effect in the central part of the left side, but much less vigorous than in the corresponding part of the right

diaphragm and an unimpaired nerve response about the rim of the diaphragm on both sides

The entire diaphragm was then excised. Stimulation was applied to the right central portion whereupon the whole right diaphragm responded, whereas the response on the left side was scarcely perceptible. The whole diaphragm was put in Zenker solution and sent to Dr Stanley Cobb in the Department of Neuropathology at the Harvard Medical School. Stained sections from the right leaf showed normal structural conditions, while in the left diaphragm, from which the phrenic nerve had been severed for ten days, evidence of active changes was present in the form of early connective tissue proliferation. The nuclei of the connective-tissue cells were larger, more numerous and less deeply stained. The muscle striation had not disappeared, but there was evidence of this alteration in its incipency. The silver stain used to determine the condition of the motor end plates failed us because we had preserved the tissue in Zenker's solution instead of formalin.

Nevertheless, the evidence thus far accumulated has served the purpose of demonstrating trophic changes in the diaphragm following nerve trauma similar to that occurring in other muscle structures following injury to nerve supply.

As a result of this change we have seen a loss in tonicity of the muscle body of the diaphragm, with a moderate degree of eventration and a probable susceptibility to recurrence of hernia after sudden increase of pressure within the abdomen.

Innervation of the Diaphragm In order to understand the alterations possible in the musculature and function of the diaphragm from injury to its nerve supply by trauma, it is necessary to know the source and distribution of the nerves which enter this important partition. By far the most important nerve to the diaphragm is the phrenic which has its origin from the fourth cervical nerve, reinforced by small roots from the third and fifth. In a dissection of these nerve roots in the cat we found only two cervical roots. Neuhofer (Neuhofer, P. *Mitteilunger Ans Den grenzgebieten Der Medizin und Chirurgie*, 35, 1922, p. 1) has demonstrated that to these nerves are attached the sympathetic fibres from the lower ganglia of the neck. Below the phrenic nerve pursues an antero-lateral course and pierces the diaphragm at the junction between the musculature and the central tendon. Under cover of the peritoneum it splits into three branches a lateral, anterior, and posterior. The rim of the diaphragm is supplied by the lower intercostal nerves. Meckel (Meckel, J. F. "*Handbuch der Menschlichen Anatomie*," Berlin, 1817) described these motor nerves in 1817 and Joseph Swan (Swan, Joseph A. *Demonstration of the Nerves of the Human Body*, London, 1830, p. 29) wrote at length on this innervation in 1830. Hence this motor intercostal innervation is pretty well established. Ramstrom (Ramstrom *Mittlg a d Grenzgeb der Med u Chir*, 15, 1906, p. 642) goes further and says, "the intercostals send not only motor but sensory nerves to the rim of the diaphragm. The serous covering of the diaphragm in its central part is supplied

by the sympathetic and phrenic, while the five lowest intercostal nerves supply its peripheral part. Felix (Deutsche Zeitschrift für Chirurgie, 1922, p. 171) in his experimental work demonstrated very fine branches from the phrenic nerve going into the peritoneum as well as into the pleura of the diaphragm. These serous endings of the phrenic nerve lie with very few exceptions in the central part of the diaphragm and again in the lumbar part of this region. Felix also demonstrated that almost all the phrenic branches which have sensory endings in the serous covering of the diaphragm are associated with the sympathetic. He believes it possible that the sympathetic controls some of the musculature of the diaphragm. Furthermore he points out the well-recognized clinical fact that irritation of phrenic nerve endings produces pain in the region of the shoulder as observed in subdiaphragmatic abscess. In addition Luschka (Luschka Nervus Phrenicus Tübingen, 1853) has shown that irritation of the intercostal nerves to the diaphragm produces pain in the epigastrium. Under these circumstances there must be a zone in the diaphragm which when irritated will produce pain that is local and pain that is referred also to the shoulder. Gerhardt (Die Pleuraerkrankungen Stuttgart, 1892) found in four cases of diaphragmatic pleuritis abdominal pain as well as shoulder pain. He referred the former solely to the intercostal nerves.

Mechanism of Rupture. With these anatomical facts before us the events associated with rupture of the diaphragm are more easily understood, though curious and engaging. Immediately following a rent in the diaphragm there is a tendency for the pressure in the pleural and peritoneal cavities to equalize. The normal negative pressure in the thorax soon equalizes with the positive pressure of the abdominal cavity. Upon inspiration contraction of the normal side of the diaphragm increases the positive pressure within the abdominal cavity, thereby pushing the swinging abdominal viscera into the opening through the ruptured leaf of the diaphragm. Here the viscera are helped along in the upward direction by suction from the expanding thorax above. Thus a double force immediately comes into play, resulting in a transposition of the abdominal viscera. As much passes through the aperture from below as the size of its lumen permits. The lung on the affected side expands in proportion to the free space in the thoracic cage. For example, at the first operation we found the left chest cavity filled with coils of intestine and the lung on the same side in a state of complete collapse. During the second operation, the aperture in the diaphragm was small and completely closed by a knuckle of intestine. Here the lung was expanding to the limit of space allowed above the small amount of encysted fluid over the diaphragm. The motion of the crippled diaphragm was observed to be limited always. Its relative position was high when only an angle of gut closed the opening, perhaps normal or readily accessible from below when a loop of the colon had passed into the thorax, and completely fallen when a large mass of obstructed and dilated gut occupied the entire thoracic cage. Under the latter circumstances the injured leaf of the diaphragm was forced into a state similar

to that of the abdominal wall in the presence of intestinal obstruction. Therefore, it is obvious that many factors come into play, making the clinical picture of traumatic hernia of the diaphragm varied and of compelling interest.

Methods of Approach The different methods employed in approaching the diaphragm in our cases afforded an opportunity for comparison under conditions that in many respects were similar. We learned at the first operation that reduction of a considerable length of incarcerated gut through the diaphragmatic opening by means of thoracotomy would be exceedingly difficult, if not impossible, unless the diaphragm was elevated to a considerable height by a finger hooked under the margin of the ring, thus creating a vacuum in the abdominal cavity, that adhesions within the thoracic cage are more easily dealt with by means of an intercostal approach, and that laparotomy in the absence of adhesions above the diaphragm is an equally good approach especially if the patient is a child. It is a less disquieting means of access because it is a more familiar operation to the average surgeon. The choice of method in approaching the diaphragm is more often an individual problem. The surgeon will do wisely to select the method which best fits into his own scheme of things.

The method of closing the opening in the diaphragm has varied considerably in the hands of different surgeons, owing to individual preferences and to the great variety in the types of hernia.

Scudder denuded the edges of the aperture in the diaphragm and used catgut and fine silk for closure. (Transactions of American Surgical Association, vol xxx p 428)

Mathews (Trans American Surgical Association, vol xxviii, p 620) employed mattress sutures of chromic gut to close the orifice in the diaphragm and anchored the stomach to the suture line of the abdominal incision.

Arthur D Bevan (Archives of Surgery, vol 1, no 1, p 23) closed the opening in the diaphragm with interrupted sutures of Pagenstecher linen. In two cases where a hernial sac existed he closed the opening of the invaginated sac with catgut, but in each case exercised the precaution of anchoring the stomach to the diaphragm or to the parietal peritoneum.

James F Mitchell (Trans American Surgical Association, vol xxviii, p 623) closed the opening with catgut. His suture line was so near the chest wall that he anchored it there with mattress sutures.

In the first operation we closed the tear in the diaphragm with a running suture of catgut reinforced by three sutures of the same material. At the second operation we enlarged the opening, denuded the edges, then closed with catgut and interrupted sutures of silk. In the last instance we prepared the aperture in the same manner and closed the opening with interrupted sutures of silk reinforced by a running suture of chromic catgut.

It is now about six months since the last operation and the child is once more apparently well.

RECURRING HERNIA OF THE DIAPHRAGM

SUMMARY

1 Recurrence of hernia of the diaphragm after many months is a liability irrespective of the method or suture material employed in repair of the hernia orifice

2 Deficiency in the musculature of the diaphragm exists as a natural sequence of prolonged limitation of function or of trauma to terminal branches of the phrenic nerve or of both of these conditions

3 The method of approach in dealing with hernia of the diaphragm may be selected to best advantage after determining the direction of greater accessibility and conditions to be met above and below the diaphragm

4 Early operation and the avoidance of such activities as produce unusual increase of intra-abdominal pressure is the only safeguard against recurrence

A METHOD OF REPAIRING INGUINAL HERNIA WITH LIVING SUTURES TAKEN FROM THE EXTERNAL OBLIQUE TENDON

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It will probably be generally agreed that recurrences after operation for the radical cure of inguinal hernia, are much more frequent than a casual reference to statistics would lead one to believe. Indeed, recurrence after

operation for direct inguinal hernia in patients over fifty years of age is so high that some operators consider operation inadvisable in this class of patients unless there are special indications.

Recent researches in the use of living sutures, especially that of Gallie and Le Mesurier, have opened up a new field in the repair of hernial openings. His experimental work has shown that "sutures of fascia lata when placed in such a position that they receive an adequate supply of lymph, continue to live practically unchanged." When drawn through "a tight needle hole they become folded into rounded cords and in the course of two or three weeks, become surrounded with a vascular areolar film which sends septa of similar tissue into the depths of the cord in the spaces between the folds. A cross-section

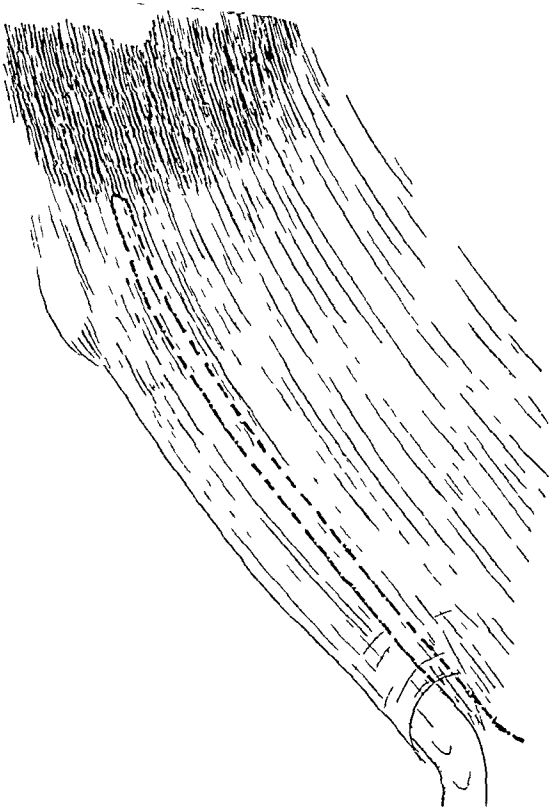


FIG 1—Showing outline of suture to be taken from the tendon of the external oblique. The superficial parts are left out for the sake of clearness.

of the suture at this time and later has the appearance of normal tendon."

It occurred to the author while operating for inguinal hernia that use might be made of a suture from the tendon of the external oblique to repair the defect. After experimenting on the fresh cadaver the method here described was worked out. I have performed the operation four times on the living for indirect inguinal hernia and have been impressed with the satisfactory closure the method gives. I believe it insures that the internal oblique will not become detached from Poupart's ligament, which operations for recurrent hernia have so frequently shown to have occurred.

REPAIRING INGUINAL HERNIA WITH LIVING SUTURES

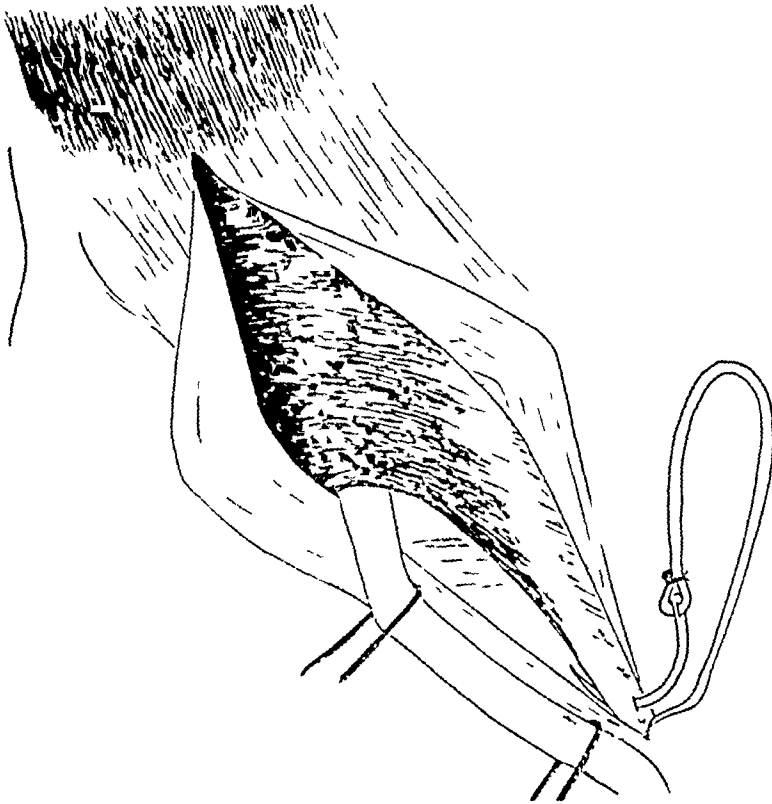


FIG 2—Showing the beginning of the first stitch, the needle passing through the conjoint tendon close to the pubis

Technic A five-inch incision is made in the usual site terminating slightly below the pubic spine. The external ring and the tendon of the external oblique up to its origin from the fleshy belly of the muscle is cleared. One blade of a pair of blunt scissors enters the external ring near its inner pillar, and with the scissors following the direction of the fibres the tendon is slit up to its origin from the muscle. A second incision one-quarter inch internal to the first is made through the tendon with

a scalpel at a point about an inch above the pubic bone. The blade of the scissors is inserted into this incision and carried parallel to the first incision up to the muscular fibres where the strip of tendon is severed from its muscular attachment. In completing the freeing of the strip of tendon below the incision at a point about half an inch from the pubic bone bends inward, thus giving the strip of tendon to be used as a suture, a wide attachment to the bone (Fig 1)

The free end of the suture thus obtained is threaded on a curved needle with a large eye, and the end secured against slipping out with a ligature of fine catgut. The needle is then passed through the conjoint tendon close to the pubis (Fig 2). This results in strain being applied in the normal direction of tendon fibres, and should ensure that the suture will not be pulled from its

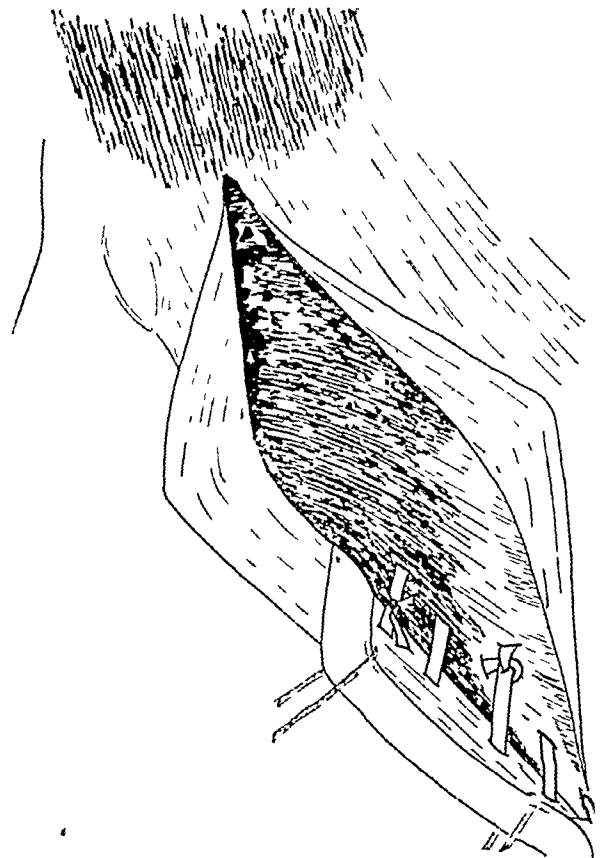


FIG 3—Showing the suturing of the internal oblique to Poupart's ligament completed. The centre stitch is locked by passing the needle through the suture and then through the loop

bony attachment. The needle now picks up the reflected portion of Poupart's ligament and the periosteum covering the pubic bone close to the spine. The internal oblique is drawn down to Poupart's ligament with additional stitches as shown in the illustration (Fig 3), the end being secured by drawing the suture through itself, splitting the ends and tying them across in a triple knot after the method of Gallie. After the knot is tied, a needle threaded with No 0 chromic catgut is passed through the knot and tied. Additional security against the knot slipping can be obtained by passing the needle beneath the suture or through the adjacent portion of Poupart's ligament and tying down the ends. The edges of the external oblique are now sutured external to the cord in the usual way.

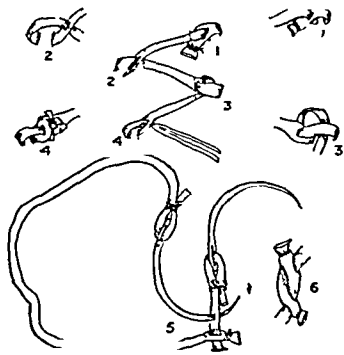


FIG 5—Diagram showing method of inserting fascial suture (1) Anchoring suture at its commencement by looping it through itself (2) Fixation of suture at each loop by passing it through itself (3) Fixation by transfixion and knot (4) Ending of suture by passing through itself, splitting and tying end in knot (5) Method of joining new suture to one that has been inserted (6) Join completed (Gallie and Le Mesurier)

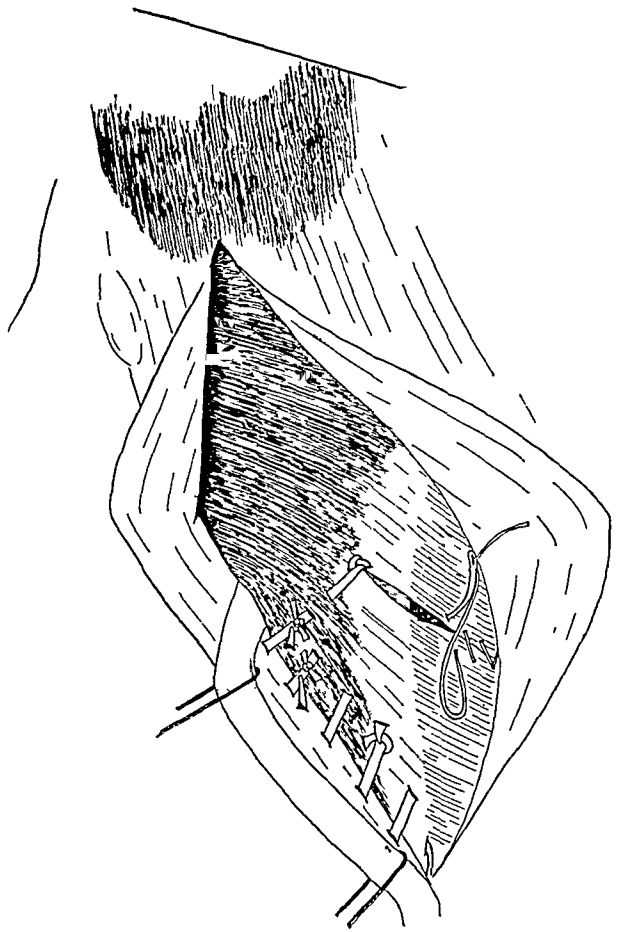


FIG 4—Showing method of using an extra suture taken from tendon of the internal oblique to close the upper end of the opening

In the cases in which I have used the method this single suture taken from the external oblique tendon has been long enough to effectively close the defect. However, if an additional suture to close the upper end be required it can be obtained, by dissecting up the external oblique tendon from the underlying tendon of the internal oblique as far as the median line. A slip of the internal oblique tendon is then cut out, leaving its muscular attachment undisturbed. This suture is threaded on a needle as before, the needle is passed through the cut edges of the internal oblique tendon, and then through the loop, thus forming a knot which prevents the suture pulling away from the muscular attachment. The needle is then passed through Poupart's ligament and up through the internal oblique and the end secured as before (Fig 4). The gap in the

REPAIRING INGUINAL HERNIA WITH LIVING SUTURES

tendon of the internal oblique from which the suture has been taken is closed with No. 1 chromic catgut.

Should the operator choose to reinforce the repair with additional catgut sutures I see no reason why he should not do so. In the cases in which I have used the method they did not seem necessary and were not used. No difficulty has been experienced in uniting the edges of external oblique tendon external to the cord without undue tension.

I have tried a variation of this method in the fresh cadaver, in which a second suture was taken from the opposite edge of the external oblique tendon, the edges of the external oblique in this case being united behind the cord. I have not used this method on the living.

The operation is simple, does not require a second incision to obtain the suture and, in the author's opinion, should lessen considerably the risk of recurrence.

CYSTS OF THE WOLFFIAN BODY

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THE extreme rarity of occurrence of cysts of the Wolffian body (mesonephros) and the paucity of reports in the literature warrants the consideration of such cases when they are encountered. For a thorough knowledge of these cysts as regards their character and location, one must bear in mind the retroperitoneal development of the Wolffian body in the lumbar region, its complex metamorphosis, the remarkable migration of its component parts and their ultimate fate, the atrophic changes which they undergo and, lastly, the vestigial remnants as they exist after complete development has occurred. The surgeon is not fully efficient who does not bear in mind the pathological potentialities of the Wolffian body in the exploration of the abdomen. These facts, together with the confusion extant in the literature, the failure of textbooks to consider the Wolffian body in differential diagnosis, renders important the consideration anew. The subject was brought to our attention by the case reported below.

The present tendency is to credit nearly all cystic retroperitoneal tumors as having their origin from foetal renal elements, unless they are definitely proven to be associated with other organs. Lobstein, in 1829, and later Witzel (Bauer) were the first to describe retroperitoneal tumors, they did not differentiate between the cystic and solid tumors and gave but little information as to origin. There appears to be some confusion as to who first pointed out the relationship between these cystic tumors and the Wolffian body. Koenig credits Roth as having been the first to point out their true etiology in 1881 (Maury), while Bauer says that Przewoski in 1886 was the initial investigator to call attention to their connection with the Wolffian and Mullerian bodies. These findings were later confirmed by Obalinsky, Niosi and von Hippel. Since then but few cases are to be found in the literature which show any true morphological relationship. All retroperitoneal serous cysts, retroperitoneal cystadenomata, etc., unless definitely associated with an organ, are put in the same group by most authors.

CASE *—L D male white, age twenty-seven months, was seen because of a swelling in the lower left flank. The family history was negative except that the father had been treated for lues. The past history showed the child to have had a normal feeding and developmental course. There was no history of any disease.

* This case is reported by courtesy of Dr Richard T Tomlinson, San Francisco

CYSTS OF THE WOLFFIAN BODY

The present illness began about six months prior to operation when the mother noticed a small swelling in the region of the left flank. This gradually increased in size until at the time of operation it was the size of a small orange. The mother states that at no time were there any gastro-intestinal or urinary signs and symptoms. No hæmaturia nor other urinary signs were noticed. The child appeared happy at all times and never seemed in distress. There was no loss of weight nor signs of emaciation, except that the mother thought the child to be a little pallid.

The physical examination showed the child to be well developed and nourished. The abdomen was flat, soft and tympanitic throughout. No areas of tenderness were made out. Palpation of the left abdomen easily revealed a painless tumor about the size of an orange which was freely movable, ballotable and seemed semifluctuant in consistency. The left kidney was not felt. The remainder of the examination was negative.

Röntgen-ray examination of the abdomen showed some vaguely outlined mass to the left of the spine opposite the third and fourth lumbar vertebrae. The urine examination was negative.

The case was seen in consultation with an urologist and it was decided that the tumor mass was in no way related to the urinary tract. A diagnosis of chylous or dermoid cyst was made and operation advised.

Operation was performed under gas and ether anesthesia. A midline incision 12 cm in length was made. The peritoneal contents were found to be normal. The tumor mass was easily felt and found to be situated retroperitoneally just caudad and somewhat anterior to the left kidney. No relationship to the left kidney could be made out. The posterior peritoncum was then penetrated and the tumor found to be a cyst about 6 cm in diameter. No pedicle was found but the attachment was by means of a broad base retroperitoneally. Adjoining this cyst was found a smaller cyst about 1 to 2 cm in diameter. The cystic mass was easily shelled out and closure made in the usual manner. The convalescence was uneventful, the child leaving the hospital on the eighth day post-operatively.

Pathological Report Gross—Specimen (Fig 1) consists of a tough, thin-walled sac in two parts which communicate with each other. The larger measuring approximately 6½ cm and the smaller 2 cm. The thickness of the wall varies considerably, but for the most part is of paper thickness and at no point is more than 5 mm. The lining of the two parts is smooth and shiny, the contents a thin straw-colored fluid.

Microscopic—Sections of the wall at the thickest point to show the lining of both cysts, reveals a rather dense fibrous wall and a very dense hyalinized connective-tissue



FIG. 1.—Photograph showing external aspect of Wolffian body cyst. The cavities of the larger and smaller cysts communicate. The larger cyst measures 6½ cm in diameter the smaller 2 cm.

lining Throughout the connective tissue of the wall are a multitude of small or large alveolar structures lined by a cuboidal or low columnar epithelium, numerous structures resembling quite closely the glomeruli of the kidney and a multitude of large, quite thick-walled vessels (Figs 2, 3, 4) An occasional large microscopic cavity which probably represents a small cyst, shows an epithelial lining varying from a single to several layers and taking mostly the low cuboidal form The structures described in the wall represent primitive glomeruli of the Wolffian body and primitive tubules The picture is typical of that of a retroperitoneal cyst arising from the anlage of the Wolffian body

Diagnosis Retroperitoneal cyst of Wolffian body origin

Pathogenesis—Intra-abdominal cysts of various types form the subject of a voluminous literature, chiefly European They are reported as having origin in nearly every structure within the limits of the abdomen, intra-, extra- or retro-peritoneal Thus there have been described pancreatic, ovarian, par-ovarian, renal, perirenal, pararenal, mesenteric, peritoneal, omental, omphalo-mesenteric, retroperitoneal, Wolffian

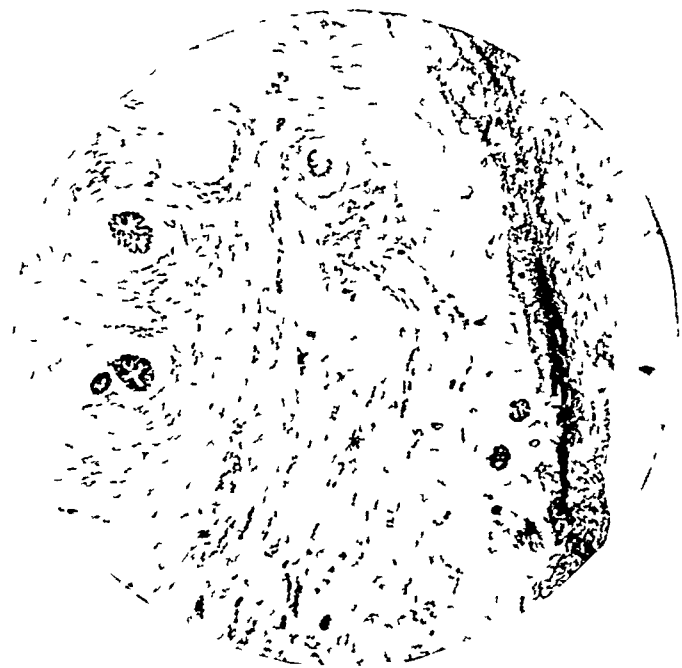


FIG 2—Microphotograph (low power) showing thickest portion of cyst wall A dense hyalinized layer of connective tissue lines the cyst cavity Note primitive glomerular and tubular structures scattered throughout cyst wall

body (mesonephric), lymphatic, dermoid, hepatic, echinococcus, chylous, serous uni- and multilocular cysts, benign and malignant cystadenomata, as well as cysts arising from remnants of the Mullerian ducts

Due to the remoteness in point of time and the obscurity which veils the origin of many of these cysts, great confusion has arisen as to their true nature and pathogenesis It has, therefore, been impossible to review the literature with the hope of selecting those cysts of definite mesonephric origin This difficulty arises not alone from the variety of locations these cysts may occupy, but from their variegated histo-pathological structure as well A cyst may be situated in the fused layers of the mesocolon and delude the surgeon into believing them intraperitoneal, or may so closely approximate the gut as to suggest an enteric origin Moreover, the histological structure may present a variety of pictures quite contrary to that of the normal mesonephric elements

There exists one definite criterion which denotes a given cyst as being of mesonephric origin and that is the presence of primitive glomeruli or

CYSTS OF THE WOLFFIAN BODY

renal tubules in the cyst wall (the cyst, of course, being independent of the kidney) This type of cyst is of the greatest rarity, only four cases having been reported on the American continent (Mauzy) The literature, however, abounds with reports of cysts which present none of these structures and yet are considered as being of Wolffian origin, either on mere supposition or reasoning by a process of elimination It is highly probable, and more evidence is gradually being collected to support the view, that a great variety of cystic and solid neoplasms of the retroperitoneal space in relation to the adrenal, the kidney, the broad ligament, spermatic cord, epididymis and possibly the testicle, have their origin in Wolffian body remnants In the last analysis the etiology of testicular tumors remains unknown and the theory is tenable that such tumors may arise from remnants of the Wolffian body Bland-Sutton has suggested the paradidymis as the origin of certain testicular neoplasms In a previous report[†] the literature on dermoid cysts of the spermatic cord has been reviewed

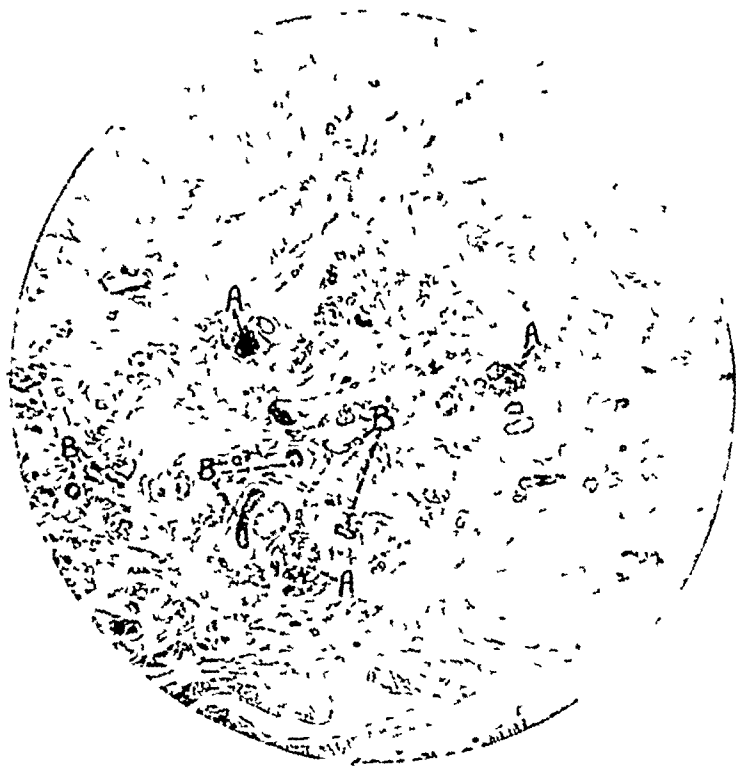


FIG 3—Microphotograph (low power) of area from cyst wall showing well formed glomeruli A, and tubules B, resembling closely the adult structure

and their origin considered Staehlin emphasizes the fact that the pronephric portion of the Wolffian duct arises in part from primitive ectoderm and suggests this as an explanation of various dermoids seen within the abdomen and along the spermatic cord In the complex development of the urogenital tract there undoubtedly exists abundant opportunities for maldevelopments, while the numerous foetal remnants left over in the process of development afford an attractive explanation for these cysts Definite evidence in support of this hypothesis is furnished by the fact that mesonephric cysts are of much greater frequency in the female sex, a fact explained by Mauzy as being due to the relatively greater amount of Wolffian body remnants existing in the female as compared to the male The latter utilizes most of his primitive urinary excretory apparatus in the formation of the vas deferens and epididymis, whereas in the female the major portion of the Wolffian body remains vestigial

[†] Hinman and Gibson Tumors of the Spermatic Cord, Epididymis, etc Arch Surg, January, 1924, p 100

It was stated above that the mesonephros definitely gives rise to cyst formation, as shown by the finding of retroperitoneal cysts with primitive glomeruli and tubules in their walls. These constitute an extremely small group and to these must be added a relatively larger group of retroperitoneal cysts which do not exhibit such structures but exhibit a more or less fibrous wall with an inner epithelial lining, varying from a simple single layer to cyst adenomatous structures. Reasoning by a process of exclusion, Jacquot and Fairise, having made a careful study, have shown that these also must



FIG 4—Microphotograph (high power) of area from cyst wall showing more or less differentiated glomeruli in a matrix of connective tissue

be considered as being derived of the Wolffian body. Maury has stated that one is forced to the conclusion that all retroperitoneal cysts not arising from retroperitoneal organs are genetically Wolffian. Jacquot and Fairise have reported such a case in an eighteen-year-old female, a large cyst containing 4 to 5 litres of fluid, situated between the layers of the descending mesocolon. They supply a very comprehensive bibliography and review the literature, collecting with their own,

fourteen cases which they consider definite Wolffian cysts.

Clinical—Eliminating the solid retroperitoneal tumors, there remains but a very small group of cystic tumors. If we further eliminate such cysts whose structure morphologically give us no clue as to their origin and confine ourselves to such as do show definite embryologic structures in their walls, it is at once apparent that such tumors are exceedingly rare. Due to the confusion in the literature and the entire absence of clinical statistics relative to incidence, no definite statements can be made. Suffice it to say, cystic tumors similar to the one reported, are most rare.

As far as we can determine they occur almost always in the female. Nor are they confined to any particular period of life as indicated by Maury's case and ours. The former occurred in a woman of twenty-eight years, while the latter was found in a male child of twenty-seven months. The youngest case in the literature is one of ten months, reported by Albarian, while Kast

has reported one in a woman of sixty-five years. For the most part it can be said that they occur chiefly during adult life.

The symptomatology is practically limited to physical signs, especially while the tumor is still small. Due to the diversified locations, the symptomatology may be variable. Then beginning is slow and progressive and may therefore pass unnoticed at first. The occurrence of a blow or fall may quite accidentally call attention to such an abdominal tumor. In children, asymmetrical prominence of the abdomen may cause the parents to examine it. Only when a large size has been attained do we begin to get subjective symptoms.

A sensation of fulness with some dull painful radiations in the lumbar region may attract attention to the tumor. Attacks of renal colic have been noted in some cases probably due to ureteral compression. As the tumor increases in size the appearance of pressure signs may become apparent. Again the location of the tumor is the main factor, tumors in the renal or perirenal position may give a neuralgia of the



FIG. 5.—Microphotograph (low power) of area from kidney of 20 mm human embryo showing resemblance to structure in wall of Wolffian cyst.

twelfth dorsal nerve, then again the situation may be in such relation to the ureter as to produce symptoms of hydronephrosis. Compression of the left renal or spermatic vein may lead to varicocele formation. Large tumors situated in the pelvis may lead to oedema and varices of the lower limbs. Rarely do ascites, compression of the portal vein or intestinal obstruction occur. If the latter is present the symptoms will be those of a chronic obstruction. Attention has also been called to the fact that urinary frequency may be caused by pressure on the bladder. From the signs noted, it is apparent that exclusive of the size of the tumor itself, the subjective and objective signs and symptoms are essentially those of pressure. That they may attain a huge size is noted by the fact that some cases have reached the capacity of ten litres.

The diagnosis is essentially one of exclusion. The making of an exact diagnosis is therefore a difficult one. Cases as a rule are only correctly diagnosed at operation or later by the pathologist. If an urological investi-

gation excludes the tumor from the urinary tract the differential diagnosis still rests on a large number of possibilities such as movable spleen, Riedel's lobe of the liver, adrenal tumor, solitary cyst of the kidney, benign and malignant peri- and para-renal tumors of a solid nature, lipoma, ovarian cyst, pancreatic cyst, lymphatic cyst, enteric cyst, omental cyst, etc. The history of a long duration is a factor against malignancy, yet certain of these cysts of an adenomatous type may become malignant, resembling ovarian cysts in this respect. These cysts when small are generally freely movable. Likewise they



FIG. 6—Microphotograph (high power) of area from kidney of 20 mm human embryo. Note the close resemblance to the primitive renal structures in the wall of the Wolffian cyst.

are generally smooth in outline, a point against solid malignant tumors. In view of the extreme difficulty of clinical diagnosis, the surgeon can as a rule, only keep in mind the possibilities. If on surgical exploration a cystic structure is found independent of the post-peritoneal organs, it may be considered of Wolffian origin. The contents of the cyst vary with the type, probably depending on the portion of the

mesonephros from which it originated. The fluid may be thin, serous, chocolate-brown or pseudomucinous in type. Whether those cysts whose walls show tubules and glomeruli contain urinary elements has not been stated. Treatment consists in early and complete removal, not only because of the inherent tendency to continued increase in size, but also because there is a tendency to malignant degeneration in certain types. The prognosis is an excellent one, excepting in those cases of malignant change and huge size.

SUMMARY

- 1 Cysts of the Wolffian body are of such rarity as to warrant reporting.
- 2 The case reported is a true Wolffian body cyst, as evidenced by the finding of primitive renal structures in its wall.
- 3 Pathologically great confusion exists in the literature, as shown by the large variety of cysts which have been attributed to Wolffian origin. In the absence of any definite relationship to retroperitoneal organs, the presence of all such cysts in that region or between the layers of the mesocolon are probably of Wolffian origin, even though recognizable primitive renal elements are not to be found in their walls.
- 4 Wolffian body cysts have generally been found in the female. This is probably due to the fact that a greater portion of the Wolffian body and duct

CYSTS OF THE WOLFFIAN BODY

become vestigial remnants in the female, whereas in the male it is almost entirely utilized in the formation of the genital tract

5 Cysts of the Wolffian body may occur at all ages, but especially during adult life

6 The symptomatology consists chiefly of secondary compression phenomena, varying with the size and location of the tumor. These cysts may grow to a volume of ten litres

7 Diagnosis is chiefly one of exclusion and is usually made at operation or on later pathological study

8 Treatment consists of early and complete removal because of the tendency toward malignant degeneration in certain types

BIBLIOGRAPHY

- Albarran Bull Soc de Chir, 1903, pp 117-119
Ashhurst and McGuire J A M A, 1920 vol lxxv, p 1494
Bauer Beitr klin Chir 1910 vol lxx p 829
Dubs Arch f klin Chir 1918-19 vol cxvi, p 860
Elder Canad M A J, 1920 vol x p 272
von Hippel Langenbeck's Arch, vol lxxviii, p 1008
Jacquot and Faurise Rev de Gyn, 1913 vol xx, p 551
Kast Rev de Gyn et d'Obs, 1904
Kroenig Betr z Geburtsh u Gyn, 1901, vol ix, p 61
Lapointe Bull et Mem Soc de Chir de Paris 1919 vol xlv, p 728
Lobstein Lehrbuch der pathologischen Anatomie Bd 1, II, Stuttgart, 1835
Maury Surg Gyn and Obs 1918 vol xxvi p 663
Niosi Clinica Mod 1907, pp 20-24
Niosi Virch Arch, 1907, p 100
Obalinski Wien klin Wochschr, 1891, vol xxxix, p 719
Przewoski Gazeta Lekarska vol xxix, p 820
Roth Virch Arch, 1881, vol lxxxi, p 371
Simpson South M J, 1923, vol xvi, p 121
Stachlin ANNALS OF SURGERY, 1915, vol lvi, p 312
Vignard Annal des malad des org gen urin, 1901, vol xix, p 1372

STRICTURE OF THE FEMALE URETHRA

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History Stricture of the female urethra was first described by Lisfranc¹ in the year 1824. After which very little appears in the literature until the work of Civiale in 1850.² This author carried out extensive urological researches, and was the first to call attention to the response of the sympathetic nervous system to urethral lesions, an important factor in this disease. In 1875, Newman recognized the importance of stricture of the female urethra and advocated its treatment by electrolysis.³ Fissaux, in his essay of 1879, presents an interesting review.⁴

Van de Warker,⁵ in his first paper in 1887 and later in 1890,⁶ states that all the great writers on gynæcological and urinary conditions seem to treat with silence a matter of great import, namely that of stricture of the female urethra. His articles are forceful and to the point.

Skene,⁷ in 1887, calls our attention to the fact that stricture while not common, occurs more frequently than we think, and often enough to require careful consideration. In the same year the question was taken up in a symposium, by the London Obstetrical Society, and a number of interesting cases reported. Otis,⁸ in 1892, says, stricture of the urethra in women may occur in sufficient extent to cause reflex troubles as varied and severe as that occasioned by urethral stricture in men, and this quite independent of any trauma. He also states that where urinary conditions do not respond well to treatment the patient's urethra should be explored by the urethrometer or the bulbous sound. Otis was well in advance of his period and his bulbous sound principle considerably antedating the excellent work of Hunner and others, with the olivary tip catheters and wax points.

Abdominal surgery and its wonderful development, both gynæcological as well as urological, with its splendid technics and excellent results, has apparently been responsible for our overlooking comparatively small things like the female urethra. Our attention has been drawn strongly toward the more spectacular things related to the uterus and adnexa or the kidneys and ureters. Great oaks from little acorns grow and the female urethra is responsible for more widespread suffering than many of us have realized. The remarks of Hunner⁹ to the effect that from recent observations he felt urologists were inclined to overlook urological conditions in the female, are certainly most appropriate when applied to the urethra. This, however, need give little solace to the gynæcologist as we all seem to have strolled in the same paths.

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In a review of some of the late works on gynæcology, notably such representative books as that of Graves,¹⁰ stricture of the urethra is dismissed in a few lines. Text-books on urology in women, of such encyclopædic scope as Kelly and Burnam,¹¹ furnish us with little of note, while standard works on urology as Keyes¹² mention it but briefly. In the larger work on modern urology edited by Cabot it is given a little more than usual consideration by Osgood.¹³

I believe we can summarize the history by saying that aside from the pioneer work of Van de Waiker and Otis, there seems to have been comparatively little research in this highly important field until the observations of Stevens and Hunner during the past few years.

Incidence In an examination of 3000 gynæcological and urological records in this country and Europe, I found four cases diagnosed as stricture of the female urethra. These were all cases that were readily diagnosed, one a carcinoma, one following an obstetric tear into the urethra and three cases of marked gonorrhœal infiltration.

Wynne¹⁴ quotes Winckel as having found 3 cases in 3000 gynæcological records. In his early essays¹⁵ and in his last text-books,¹⁶ Winckel also states it is rare. Meisel,¹⁷ of Budapest, found 378 strictures in the male to one in female. Pasteur¹⁸ collected 112 cases from the literature. Fischer¹⁹ records 4 cases in 4000 records. Herman,²⁰ in England, noted 69 cases. The similarity in the percentage reports in the larger series are very striking.

Osgood tells us that the urethra in the female is analogous to the membranous urethra in the male. Stricture of this portion of the urethra in the male (because of its squamous epithelium which offers resistance to infection and its absence of glandular structures in a continuation of the mucosa) is rare. This Osgood further tells us is the condition existing in the female urethra as well. Reasoning in this manner seems very sound both from an anatomical and theoretical standpoint.

Hunner,²¹ in his contributions to the literature, speaks of narrowing of the urethra associated with ureteral lesions. In some of his case records of ureteral cases, notes of urethral infiltrations also occur. He is quoted by Stevens as finding 60 per cent of those suffering with ureteral stricture to have urethral stenosis in addition. Bugbee²² states that he is surprised to find the extent to which stricture of the urethra exists in women.

Stevens,²³ of San Francisco, believes that stricture of the female urethra is an important condition that has only recently been accorded real recognition, being constantly overlooked by both gynæcologist and the urologist. In 169 urological cases in women he found urethral stricture in 90. This series is certainly worthy of our attention, as it emphasizes quite strikingly the frequency of the disease.

In an examination of 180 women presenting urological symptoms I have found urethral stricture in varying degree in 35, and I believe we are justified in calling this common. Stevens makes a good point when he states that strictures of the female urethra are overlooked because we too readily accept the oft-stated opinion that they are rare.²⁴ If there is one point on which most writers heretofore seem to agree it is that stricture of the female urethra is rare.

Etiology The causes of stricture of the female urethra given in the literature are many and varied. It will suffice to consider the more common factors

Most of the older writers seem to cling rather strongly to the traumas incident to childbirth as most important, Winckel notably placing it above all. Many cases of trauma other than obstetrical are noted by mid-European writers, as Stoeckel²⁵ and Pleschner²⁶. Stricture following catheter injuries are noted by Teleky²⁷, Hoehne²⁸ and others. Tumors as direct causes are noted by Goldschmidt,²⁹ Thompson,³⁰ Kleinwachter³¹, Teleky and Heinrichsdorf,³² although little detail is given as to the pathology of these growths. Caruncle and papilloma are however, mentioned. Herman³³ speaks of lupus, Duncan³⁴ of luetic ulceration. Gallabin³⁵ syphilis, Routh³⁶ of a stricture following parametritis. Goldschmidt of syphilis, Duncan of cirrhosis. Senile prolapse, vesico vaginal fistula and congenital narrowing are also noted by European writers.

Skene always practical, says the causes are usually the same in women as in men, or in other words, gonorrhœa in the vast majority of cases. Graves notes gonorrhœa and childbirth as a cause, Kelly and Burnam and also Osgood mention gonorrhœa, syphilis and tuberculosis as factors. Hunner believes in focal infections, but Stevens thinks they play no great part. I cannot see why, if focal infections are recognized as playing a part in ureteral strictures, they should not be held responsible for urethral lesions, particularly when one considers the tissue structure of the two organs. Hunner seems to have proved his point I believe and some of Skene's cases also suggest focal infection.

In my own series of cases, the etiology was as follows: Gonorrhœa 24, chancroid 2, syphilis 1, childbirth trauma 1, keloid 1, possible focal infection 5.

This list shows a great preponderance of gonorrhœal lesions and in my own mind I am fully convinced that it is the main factor in stricture of the female urethra. It is also possible that some of these focal infections so noted were gonorrhœal although this infection was vigorously denied by all.

Pathology. Our knowledge of the pathology of the female urethra and particularly as applied to stricture is not extensive. In view of my findings, gonorrhœa plays an important part in the pathology and a gonorrhœal process is usually the first stage of the disease leading to stricture. A stricture may be defined to be an organic change in the wall of the canal with a narrowing of its calibre and a diminution of its normal dilatability. The stricture formation usually begins on the floor of the urethra and at the point where the gonorrhœal process has reached its greatest intensity. From what we can see with the cysto-urethroscope and note with the bulbous bougie there are both soft and dense strictures. In fact I believe we can go a little farther and apply there a classification similar to that of Oberlander's for infiltrations namely soft strictures and hard strictures of the first, second and third degree.

In lesions following obstetric trauma we have the pathology of the ordinary crushing type of injury. Ulcers and neoplasms, such as carcinoma, sarcoma, papilloma etc., differ in no way from their general characteristics as noted in other parts of the body.

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Symptoms A carefully taken history is most essential and everything in relation to the patient's previous condition must be clearly brought out. A history of venereal infection is often difficult to obtain, particularly in our better class of patients. The fact is, many may not know that they ever had it, as the ignorance of most people regarding venereal infections or sex matters is astounding. A history of whites or leucorrhœa should always be looked on with suspicion. Many patients who have had venereal infections may lead us astray in our examinations. Men, we know, frequently think they are deceiving us, even when we show them the gonococcus, women even more so.

Any history of childbirth injury should be noted, or an operation following the same, such as urethio-vaginal fistula. Obstetricians tell us injuries apparently mild sometimes produce these conditions. A history of malignant disease or tuberculosis is important. The infectious diseases, scarlet fever, typhoid and pneumonia, as possible factors, are well worthy of attention. Localized foci of suppuration should also be noted. Do not overlook the local use of cauterants or strongly astringent vaginal douches.

Gynæcologists tell us that the clinical history of such a case is not marked until the patient notes an increased difficulty in emptying the bladder, which difficulty may at times be extreme. One would naturally expect this to occur, but this is by no means always the case. In fact, in most cases frequency and dysuria are the symptoms most commonly complained of, and in several the symptoms more strongly suggested abdominal and renal lesions than they did urethral. Many cases present most remote symptoms, and if one is not careful, we may put them down as neurotics. The retention of urine by women for long periods is so common that they often seem to think it a natural condition. Far more do women complain of dribbling (really an incontinence or retention) than they do of obstructive symptoms. Slight obstruction, however, is often sufficient to produce a marked cystitis and urinary changes. Some writers tell us that symptoms of urethral stricture occur earlier in women than they do in men and this is possibly true.

The symptoms of importance in my series of cases were dysuria, urgency and frequency, signs of auto-intoxication were also common. In the advanced cases actual obstructive symptoms were present. The reporting of cases by Stanton, in which renal colic was associated with urethral stricture in the female, are valuable as they bring out the relationship of the urethra and the renal organs through the sympathetic nervous system. This is a syndrome which has been but little noted before, but of which many of our patients complain in a greater or less degree. In view of what we have learned from our cases, we must not look for the classical text-book symptoms in urethral stricture in women, as it is unusual to find them. If, however, we take a careful history and find any suggestive urinary symptoms, we are justified in making a urethral examination. In fact, we should do it as a routine in all our female urological cases, using for the purpose either the olive tip bougie or the bulbs.

When we are able to use a small urethroscope we find that it meets an obstruction, and on withdrawing it we find the scar. Meltzer says urethral infiltrations are commonly found on the floor where the glands are most numerous. Hard infiltrations not only can be seen, but at times cause quite a tug on the instrument. In hard infiltrations the mucosa looks pale and on withdrawing the instrument the canal seems to have lost its elasticity and does not readily collapse. The urethroscope should always be used when possible to do so. The Rontgen-ray as a diagnostic medium has not been satisfactory in this class of cases.

What is a Stricture? Text-books of anatomy state that the female urethra is from $2\frac{1}{2}$ cm. to 3 cm. long and about 7.5 mm. in diameter with a spindle-like dilatation in the centre. Herman found that the urethra in 56 patients between the ages of eighteen and seventy, varied between 7 and 12 mm. in diameter. Van de Warker believed that a urethra taking a bulb less than 16 F. was abnormal. Bugbee calls a stricture those in which there is difficulty in passing an 18 F. sound. Stevens says strictures above 18 F. will often cause symptoms and thinks 26 F. is normal. In 114 of his patients the urethral caliber averaged 22 F. and apparently they had lesions, his smallest was not above a filiform. None of my patients took above a number 18 F. and all had symptoms. I believe Bugbee is conservative and that a caliber of 22 F., as noted by Stevens, is at least a narrowing. The following table represents the calibers of my series.

Filiform stricture	1
No. 8 F.	2
No. 12 F.	5
No. 14 F.	8
No. 16 F.	12
No. 18 F.	7
	—
Total	35

It is true I have seen cases above a number 18 F. that were suggestive of stricture but I have not been able as yet to fully convince myself on that point. Further investigation in this line may change my opinion as it has regarding ureteral stenosis.

Location. The stricture may be situated in any one portion of the urethra or it may involve the entire canal. The anterior one-third, particularly at the meatus, is decidedly the more common. A series of cases collected by Wynne show four involving the entire urethra, nine at the external meatus, fourteen in the anterior third, seven in the middle third and four in the posterior third. In my present series the lesions were located as follows: External meatus 18, anterior third 12, middle third 1, posterior third 4.

Differential diagnosis and Prognosis. The differential diagnosis presents no difficulties. Inspection, palpation, the use of the bulbous bougie or olive tip and the urethroscope should leave little in doubt. The etiological factor is important and may be difficult to determine. The prognosis depends largely on the

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etiological factor Soft infiltrations usually respond well to treatment, while the hard infiltrations are always a source of doubt as to their ultimate cure

Treatment The female urethra is a delicate organ, very susceptible to injury, and must therefore be treated with care Various authors have recommended gradual dilatation, modified rapid dilatation, rapid dilatation and electrolysis, in those cases where complete obstruction does not exist

In the impassable strictures, internal and external urethrotomy have been recommended If the stricture is found to be soft, as detected by the bulb, a careful modified rapid dilatation may be done This will, however, usually necessitate the use of either a general anæsthetic or the use of caudal anæsthesia In case modified rapid dilatation is used, I do not believe it ever advisable to dilate over six points at any one sitting, as, for instance, from a six to twelve I once saw an operator use a small pair of forceps in an attempted rapid dilatation, with profuse hemorrhage resulting Personally I should never recommend any rapid form of urethral dilatation It is always best to begin the dilatation with the largest sound or bougie that will pass the stricture and then increase two numbers a week, until we reach the normal urethral calibre which I believe is around 26 F After this, the large dilator should be passed once a month for a year and even after that it will be wise to have them come in every six months for a while to see if there is any evidence of a return

In the hard infiltrations our treatment must be even more cautious than it is in the soft While it is advisable to advance two numbers a week if possible, we should go a little slower where the yielding of the tissues is less as laceration readily occurs We usually succeed in dilating a hard stricture but it takes a longer time and they are very prone to recur Kelly has instructed some of his patients how to pass the sound so that the patient can keep up the treatment at home

In those cases of impassable stricture of the female urethra, and even in some of the filiform strictures, it may be necessary to do a urethrotomy If possible this should be an internal urethrotomy, somewhat as follows

A filiform bougie should be passed and a Rand knife with a fine blade should be threaded over this An attempt should then be made to cut through the stricture After the urethrotomy, sounds should be passed as in the larger strictures

Osgood states that in marked cases it is necessary to do an external urethrotomy through the anterior vaginal wall This operation should certainly be avoided if possible Hoehne has reported a case of gonorrhœal stricture in which it was necessary to resort to suprapubic cystotomy and retrograde catheterization.

In the treatment of those conditions due to tumor, radium or radical operation may be necessary. Kelly and Burnam also suggest the use of radium in dense strictures, but state they have had no personal experience with it

I have not discussed rapid dilatation and electrolysis, because the former

is never to be used and the latter has little real value. A long experience with urethral lesions has taught me, that simple remedies and extreme gentleness are always to be considered. This applies particularly to the female urethra.

The following records are those of representative cases

CASE I—Mrs J G, white, married, age twenty-seven, U S. Was brought to the hospital in an ambulance, complaining of pain over both kidney regions, most marked on the right, with inability to hold her urine.

Family history negative. Previous personal history. States that aside from measles in childhood she has always been well. Denies any venereal disease, but states that two months ago she had a small sore near her urethra. She was very anxious to get rid of this lesion and went to a dispensary for relief. The house officer gave her a black solution and told her how to apply it. The doctor said she was to return in a few days if she was not better and he would touch it up with carbolic acid. The sore did not improve but instead of returning to the dispensary she obtained some carbolic acid and applied it rather vigorously herself. The sore became very much worse for a few days and then cleared up by the use of a talcum preparation.

Present Condition—Patient states that about one month ago, she noticed a more frequent desire to urinate, that her urine was cloudy with an unpleasant odor. She took some patent medicine without any relief. One week ago she noticed a tendency for her urine to dribble away and about this time began to experience a neuralgic condition over both kidneys but most noticeably on the right.

Examination reveals a small urethral orifice surrounded by a scar, through which we were able to pass a No 8 F olivary tip catheter and which on withdrawing was grasped at the meatus. The bladder urine in this case was very cloudy and a large amount was at once expelled around the catheter. Following this a No 10 F olive point was passed, with the result that the patient felt very much relieved. Subsequently she was dilated up to No 26 F at the rate of two numbers a week. There was a low grade, hard infiltrate in this case which extended a very short distance within the urethra. A small cystoscope later showed a clearing cystitis, which soon cleared with dilatation. Aside from a little pus the urine showed no other evidence of importance. Her blood chemistry was normal. Kidneys and ureters also normal. End result cure.

CASE II—Mrs McG, white, aged thirty-six U S. Family history negative. Previous personal history. Scarlet fever in infancy. Influenza two years ago. Denies any venereal infection, but sometime ago may be about five years, she had a severe attack of the whites that lasted about a year.

Present Condition—Constant desire to pass urine which at times is very urgent, but succeeds in passing a very little each time. Examination shows a very small urethral orifice through which a filiform was passed with difficulty, but we were unable to pass anything else. The filiform was made fast and allowed to remain over night and an attempt made the next morning to pass other instruments without success. We then threaded a Rand knife over the filiform and forced it through a very hard stricture, which seemed to extend almost a centimetre into the urethra. Following this we were able to pass a number eight olivary tip and she responded well to dilatation, but is still having a sound passed every two weeks. A well-marked cystitis was present in this case, which slowly responded to treatment. Kidneys and ureters normal. Blood chemistry normal.

CASE III—Mrs Ha J, age forty, white, Italian. Family history. Father died of unknown abdominal condition at fifty-five. Mother of pulmonary tuberculosis at forty-seven, three sisters and one brother alive and apparently well.

Previous personal history. Has had rheumatism for years. History of profuse vaginal discharge three years ago. Present complaint. Frequency, dysuria and at times

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urgency and dribbling of urine Examination notes at once a chronic vaginitis Urethra seems to be surrounded with granulations, which apparently do not obstruct the orifice Urethra readily admits a urethroscopic tube size No 22, but which is stopped at about two centimetres by a hard obstruction A distinct area of infiltration surrounding almost the entire urethra was seen at this point A number eight urethral catheter was the largest we could get through into the bladder This was left in until the next day, when we passed a number ten, and from this point on she was dilated two numbers a week up to 26 F Urine in this case contained considerable pus and staphylococci, well-marked cystitis also present Kidney and ureters later found normal Cysto-urethroscopy showed the infiltrations around the deep urethra and bladder neck to be identical with those of the gonorrhœal infections Discharged cured

These cases are in sufficient detail to give a fairly good idea of what one may expect to encounter in the average run of cases.

SUMMARY

- 1 Stricture of the urethra in women is common
- 2 The principal cause is a gonococcus infection
- 3 The pathology is quite similar to that of urethral stricture in the male
- 4 Its most common location is at the external meatus
- 5 Most common symptoms are, frequency, urgency and dysuria.
- 6 The diagnosis may always be established by olivary tip, or bulbous bougies
- 7 Prognosis is good in soft infiltrations, while that of hard infiltrations are doubtful
- 8 Treatment is best carried out by the use of very gentle dilatation Operative procedures always to be avoided if possible

REFERENCES

- ¹ Lisfranc, J Des retrecissemens de l'uretre Trad du Latin avec des notes, par J B Vesigne et J B Ricard, vol xvi, 148 pp, 8' Paris Bechet, Jeune, 1824, published originally as a Paris concours theses in Latin in 1824 under the title of an eadem contra varias urethræ coarctiones species medela 58 pp 4', 1824
- ² Civiale, M Traite pratique des maladies Genito-urinaires Paris, 1850, p 45
- ³ Newman, R Stricture of the Urethra in Women and its Treatment by Electrolysis American Jour Med Sciences, vol lxx, 1875, p 433
- ⁴ Fissaux, E Des retrecissemnts de la urethræ chez le femme Annal di Gynecologie, Jan and Mar, 1879, Paris, Theses
- ⁵ Van de Warker, E Stricture of Urethra in Women Med News, Phila, vol li, p 59, 1887
- ⁶ Van de Warker, E Stricture of Female Urethra Jour A M A, vol xv, p 490, 1890
- ⁷ Skene, A Diseases of Bladder and Urethra in Women New York, W Wood and Co, 1887, p 331
- ⁸ Otis, F K Reflex Irritations and Neuroses Caused by Stricture of the Urethra in the Female Med Record, New York, Jan 9, 1892, vol xli, pp 34 to 37
- ⁹ Hunner, G L Importance of Focal Infections in the Urinary Diseases of Women Urological and Cutaneous Review, vol xxiv, 1920, p 627
- ¹⁰ Graves, W P Gynæcology Saunders and Co, Phila, Pa, 1923, p 273
- ¹¹ Kelly and Burnam Diseases of the Kidneys, Ureter and Bladder New York, 1922, D Appleton, pp 585-587
- ¹² Keyes, E L Urology New York, 1917, D Appleton, p 145

- ¹³ Osgood, A T Strictures of Female Urethra, in Modern Urology Cabot, Phila, Pa, Lea and Febiger, 1920, vol 1, pp 364-366
- ¹⁴ Wynne, H M N Stricture of Urethra in the Female Surg, Gyn and Obstetrics, Feb, 1922, vol xxxiv, pp 208-214
- ¹⁵ Winckel, F Handbuch der allgemein und specielle chirurgie Billroth and Pitha, Section die Krankheiten der Weiblichen Harnrohre und Blasen, pp 137 to 139, Dresden, 1885
- ¹⁶ Winckel, F Diseases of Women, Including the Diseases of the Urethra and Bladder Trans by Parvin Blakiston, Phila, 1889, p 175
- ¹⁷ Meisel, W A Uber strikturen der weiblichen urethra Wien med Woch, 1893, vol xlin, pp 489-551
- ¹⁸ Pasteau, O Etude sur le retrecissement de la mal urethræ chez le femme Annals Org Genito-urin, Paris, 1897, vol xv, p 799
- ¹⁹ Fischer, J Strickturen der weiblichen urethra Centralblatt fur Gynak, vol xix, 1895, p 1039
- ²⁰ Herman, G E Stricture of Urethra in Women Trans London Obstet Society, vol xxi, 1887, pp 27 to 51
- ²¹ Hunner, G L Intractable Bladder Symptoms Due to Ureteritis JI Urol, vol iv, 1920, p 5
- ²² Bugbee, H G Frequency of Urination in Women J A M A, vol lxxviii, March, 1917, p 699
- ²³ Stevens, W C Urology in Women J A M A, Dec 8, 1923, vol lxxxi, No 23, pp 1917, 1918
- ²⁴ Stevens, W C Stricture of the Urethra in Women Cal State Med Journal, vol xx, Feb, 1922, pp 51-53
- ²⁵ Stoeckel, W Der Erkrankungen der Weibliche Harnorgane Veit's Handbuch der Gynak, 1907, Band ii, p 293, Wien
- ²⁶ Pleschner, H G Die Traumatischen verletzungen die urogenital apparat Zeit f Urolog Chir, vol iii, 1917, p 412
- ²⁷ Teleky, D Traumatische strikture der weiblichen urethra Zeit f Urolog Chir, vol i, July, 1922, pp 424-426
- ²⁸ Hoehne, O Uber die Behandlung einer schweren katheterisms Verletzungen der Weiblichen urethra Zeit f Gynak, vol xlii, No 39, Sept 25, 1920, p 1081
- ²⁹ Goldschmidt, J Stricture und Verlagerung der urethra bei einer Frau Beitrage zur Geburts und Gynak, 1874, Band ii, Sec 10
- ³⁰ Thompson, Sir H Stricture of the Urethra, 4th edition Lond, 1885, p 32
- ³¹ Kleinwachter, E Einige worte uber verengerungen der weiblichen urethra Zeit f Geburts und Gynak, Band xxviii, 1894, pp 122-125
- ³² Heinrichsdorf, P Strickturen der weiblichen urethra Zentralblatt fur Gynak, Band xlii, No 39, p 1081, Sept 25, 1920
- ³³ Herman, G E Lupus of Female External Genitalia Trans London Obstet Soc, vol xxi, 1887, pp 27-51
- ³⁴ Duncan, J Ulceration of Lupus on Female Generative Organs Trans London Obstet Society, 1885, vol xxii, p 313
- ³⁵ Gallabin, A L Stricture of Urethra in Women Trans London Obstet Society, 1887, vol xxi, pp 50-51
- ³⁶ Routh, A Stricture of Urethra in Women Trans London Obstet Society, 1887, vol xxi, pp 50-51

WOUNDS OF THE LOWER EXTREMITY COMMUNICATING WITH A FRACTURE OR JOINT

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COMPOUND fractures of the lower extremity are a fairly common type of injury encountered in a large hospital with a traumatic service. Less frequently seen are cases that have wounds connecting with joint cavities which may be accompanied with an open fracture or with a simple fracture in close proximity. In a period of four years, 1919-1922, 42 of the 439 frac-

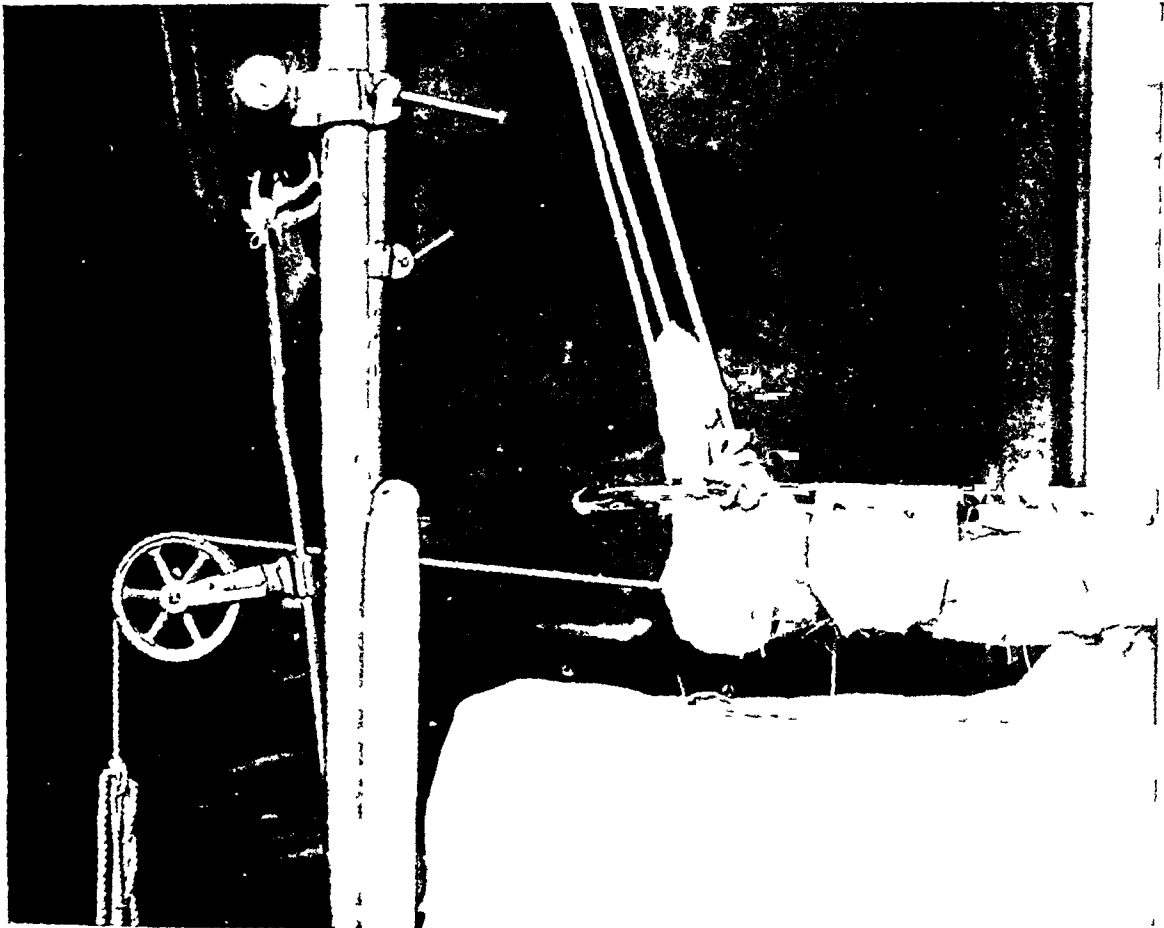


FIG. 1.—The plaster traction skate lateral view

tures of the lower extremity (femur, tibia, fibula, os calcis) treated on the First Surgical Division at Bellevue Hospital were of these two groups. A percentage of nearly 10 per cent. These cases tax the ingenuity and perseverance of the surgeon in order to obtain satisfactory anatomical and functional results. Besides the proper reduction and immobilization of the fracture, the injury to the skin and soft parts and the possible connection with a

joint cavity makes these cases much more difficult to handle than the simple fractures

The cases in this series were divided as follows Femur Upper one-third, 1, middle one-third, 4, lower one-third, 4, total, 9 Knee-joint, 1, leg upper one-third, 4, middle one-third, 13, lower one-third, 14, total, 31, ankle-joint, 1, total of all cases, 42

The ages varied from twelve to sixty-five (no children's service) There



FIG 2 —The plaster traction skate overhead view

were 38 males and 4 females in the series Length of stay in the hospital varied from 3 to 158 days The mortality was 5 deaths, or 11.9 per cent

Etiology Practically all cases were the result of some violent accident, run over by auto, struck by auto, crushed in elevator, or between trucks, fall out of a window, kicked by a horse, etc

Whether the resulting injury was by direct or indirect violence, was difficult to determine in many cases In most instances it was probably by direct violence

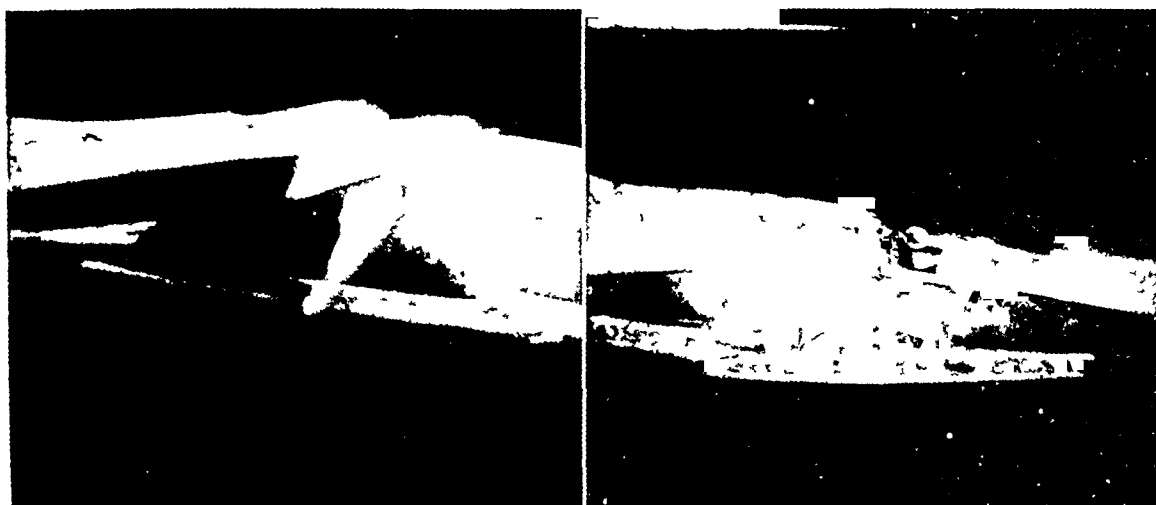
Shock Patients were brought to the hospital in all degrees of shock It was therefore necessary to treat this condition first when it was severe

FRACTURE—JOINT WOUNDS OF LEG

All but three cases were brought to the hospital shortly after the accident. Two of these developed osteomyelitis and the other required immediate amputation.

Type of Injury The cases varied from the simplest small punctured wound to the extensive laceration and maceration of the skin and soft parts. The fractures, from the simple usually oblique, to the comminuted fractures with or without loss of bone substance. In several cases there were evidences of injury to the larger blood-vessels and in one case the torn ends of both the anterior tibial artery and vein could be seen in the wound.

Treatment This was not uniform, depending on the amount of damage to the soft parts and type of fracture present. Generally it may be stated that in most of the punctured wounds where there was only a simple fracture, the wound was treated conservatively, injection of iodine, sterile dressing, etc. The next type of case, where there was a laceration of the skin, and soft parts



FIGS 3 and 4 —Compound comminuted fracture of the both bones of leg, elevator crush (case 2487)
Showing condition after plating, (case 2487)

without too much maceration or ground-in dirt, were débrided, sterilized as much as possible and sutured. This procedure worked very well in 8 out of the 12 cases tried and certainly shortened their hospital detention considerably. The fact that it failed in four was probably due to the inadequate debridement in these cases or that the skin was not viable and sloughed away.

Where the traumatism had been too severe to allow primary suture different methods were used after débriding the wound. The wound being left wide open, it was either Dakinized, or packed with dichloramine-T gauze, or flavine gauze, etc.

As regards the fracture, the treatment depended on the condition of the soft parts and the fracture itself. Attempts were made to overcome the deformity or overriding as soon after the accident as possible and to immobilize the fragments by overhead suspension, traction and countertraction. Calipers when feasible were used. On several occasions where the wound was débrided and sutured and the bone fragments could be easily held in alignment, moulded plaster splints were used with very good results.

In several other cases, where it was thought advisable to use calipres or the Steinman nail in the os calcis, traction was kept up by means of a plaster skate (Figs 1 and 2) This worked very well, a traction force up to 20 pounds easily being maintained

In all the series only two cases were plated, one a femur (History case No 70), where the punctured wound healed and in spite of traction on the Hawley table and application of plaster case, overriding and posterior displacement could not be overcome Calipre traction was not attempted, as the fracture was in the lower third of the femur and evidently extending into the joint The plating was done three weeks after the original injury, at which time a collection of yellowish fluid was found around the fracture, the bony ends showed very little notching and the medullary cavity was shut off by a round mass of scar tissue One week later there were distinct signs of infection and the wound was drained A large amount of broken down clot was evacuated It was interesting to find that the culture of the fluid found both at the first operation and on draining the wound, showed the same identical aerobic and



FIG 5 —The exposed bone ends held by plate (case 2487)

anaerobic gas-forming staphylococci The wound finally healed, but the lower bony fragment was found to have angulated backwards loosening the plate, so it was removed six weeks later At that time the plate was found to have broken For some time later there was a discharging sinus, but one year after the accident there was firm bony union, with one-half inch shortening, and the knee motion showed complete extension and flexion to 85°

The other case plated was a boy (2487) sixteen, who had his left leg crushed between an elevator and floor Brought in shock, February 24, 1922 Treated for this first, then wound extensively debrided and packed with flavine gauze There was a comminuted fracture of both bones of leg at the junction of middle and lower third Leg put up in Thomas splint, overhead suspension and foot traction by means of plaster skate Virulent infection of fascial planes Six weeks later bone ends loose and practically denuded for a distance of one inch in a large wound cavity Under gas anæsthesia wound cavity was cleansed and two short Lane plates were put in the apparently dead bone ends in order to immobilize the fragments and in the hope that granulations would develop and start some callus formation This did occur, and four weeks later leg taken out of suspension and moulded plaster splints applied Granulations filled up the wound and one plate removed At the end of two months the second plate was removed with the upper sequestrum *en masse* There was apparently good union,

FRACTURE—JOINT WOUNDS OF LEG

the callus having completely surrounded the dead bone and replacing it. The wound gradually closed down to a small sinus to the remaining sequestrum and this was finally removed about ten months after the original injury.

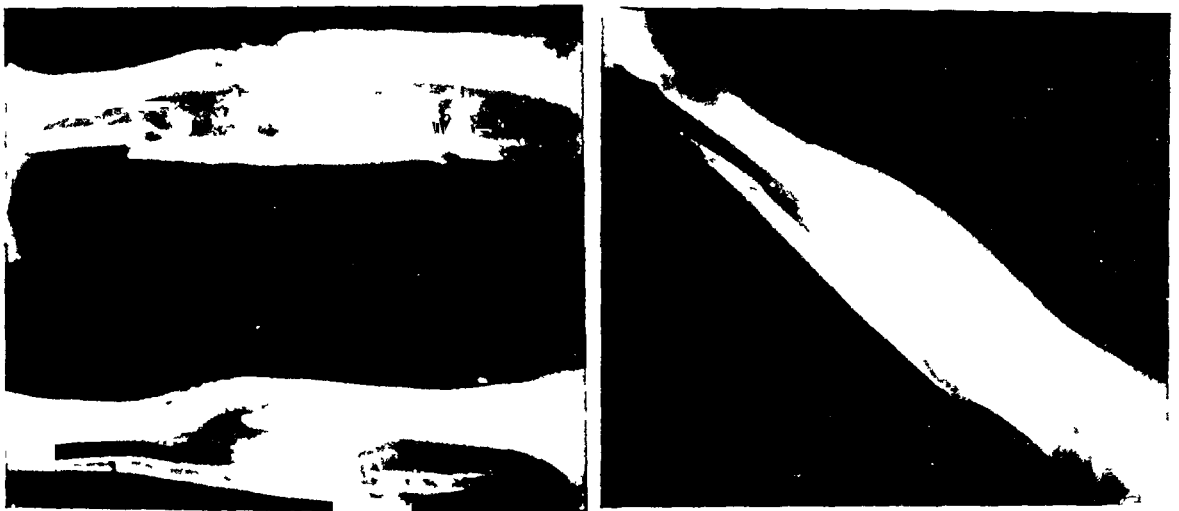
Follow-up, January 17, 1923. Walks with slight limp, has slight posterior bowing of leg. Small ulcer at site of original wound. No sequestrum felt. Ankle and knee motion good.

September, 1923. Eighteen months after the injury. Patient has compensated for shortening and walks straight. Ulcer all healed and function of leg normal.

Amputation. Ten cases, 23.8 per cent, came to amputation, seven of the femur and three of the leg. Four of the seven femur amputations died.

Before amputating every attempt was made to save the limb, only two amputations being done within 24 hours of admission.

Reasons for amputating. CASE I—Twenty-two-year-old girl, had leg badly crushed



FIGS 6 and 7 —Condition six months after plating, plates removed, upper sequestrum still present, note the callus formation, (case 2487)

in an elevator accident. Not in shock. No possibility of saving leg. Amputation below the knee. One year later walking with artificial leg, no limp, no pain.

CASE II—Fifteen-year-old boy, had foot and ankle crushed in a railroad accident. Brought in 24 hours later. Evidence of gas gangrene, not in shock. Amputation mid-leg. Did well. One year later working, using artificial limb, no limp.

CASE III—Twelve-year-old boy had foot and ankle run over by truck. Attempt made to save foot. Not successful, amputation on fourth day. Has had to have revision of stump. Now 28 months after accident, wound healed, but is not wearing artificial limb.

CASE IV—Sixty-year-old man, leg caught in buzz saw, compound fracture of lower end of fibula, avulsion of skin and muscles up to knee. Developed gas infection, amputation under spinal anaesthesia at mid-thigh on fourth day. Two years after accident. All healed, uses crutch, will not use artificial leg.

CASE V—Sixty-year-old man, had left leg caught in tow-line, causing a triserial compound fracture above ankle joint. Developed severe infection in spite of extensive debridement and Dakinization. Amputation under local anaesthesia, mid-thigh. Healed well. Eleven months later, is wearing improperly fitted artificial leg, but gets around fairly well.

CASE VI—Nineteen-year-old laborer, fell four stories, sustaining a compound intercondyloid fracture of the femur. Treated for shock on admission. After 24 hours wound debrided and thigh placed in overhead suspension and traction applied. Developed gas gangrene on second day post-operative and amputation done at site of fracture,

leaving wound wide open Positive B Welch culture Did well Three months later, wound revised, several small sequestra removed Healed nicely Twenty months after accident has good stump, walks well with artificial leg

CASE VII—Thirty-four-year-old fireman Compound fracture of lower one-third femur Crushed between two trucks Had a large crushing wound above the knee-joint and communicating with it Treated for shock, then wound and joint debrided and cleansed Joint synovia sutured, rest of wound packed with flavine gauze Put up in Thomas splint and traction applied Did well for two weeks when he suddenly

developed high fever and suppurative arthritis suspected Next day signs were definite and amputation at mid-thigh done Did not rally from amputation shock and died that night On examination of the knee after amputation, it was found that there was extensive suppuration in it with extension into popliteal space In this case up to the sudden rise of temperature there had been no premonitory symptoms

CASE VIII—Male, sixty-four Compound fracture lower one-third femur Fell off low bench and hurt right thigh There was a small punctured wound one inch above the patella Some fluid in joint Skin of thigh and knee cleansed, wound margin and subcutaneous tissue excised Mole skin traction with Thomas hip splint Developed wound infection Amputation on third day, but did not survive, dying next day Culture showed no anaerobic bacteria but many staphylococci and B coli

FIG 8—Case 2835 Medial view of knee-joint with gas gangrene infection Upper part of wound shows original laceration lower part shows drainage incision into joint

CASE IX—Twenty-year-old salesman Compound fracture middle one-third femur Fell out of window Treated for shock and laceration cleansed Next day wound extensively debrided and bone fragments put in alignment Dakin treatment Suspension traction Temperature kept steadily high, 102–104°, and on fifth day extensive incisions made laterally and posteriorly, through-and-through drainage Thick pus evacuated but no gas Patient septic but blood culture negative On the fourteenth day amputation done as patient seemed to show no resistance to local infection Did not improve, and died next day

CASE X—Fifty-five, stableman Compound fracture upper one-third femur Kicked by horse Two cm punctured wound on right thigh compound with fracture Considerable laceration of soft parts Debridement and Dakin gauze packing Distinct

FRACTURE—JOINT WOUNDS OF LEG

crepitus appeared in wound on third day. Wound opened and extensive incisions made. Showed no improvement and thigh amputated same night, but patient died shortly after. Clinically a case of gas gangrene, but cultures were negative.

Mortality As has been stated previously there were five deaths, the last four cases above cited in which amputation was done and the following case

CASE XI—Fifty-four-year-old carpenter, with a compound fracture of the middle one-third of the femur and a fracture of both bones of the leg. He had been crushed between an elevator and a floor. Wounds debrided and cleansed on admission. Traction difficult to apply and maintain on account of extensive wounds. One week after admission infection not controlled and gas gangrene suspected, culture negative. Too weak to stand amputation and died on sixteenth day after accident.

These five deaths make a mortality rate of 57 per cent in the femur cases. A high mortality but every one of these cases were desperate cases, the infection apparently being the overwhelming feature. As far as the age is concerned it does not seem to have any bearing on the deaths, as two of the femur amputations that survived were both men of sixty years of age.

Infections Many of this series, especially the cases with small punctured wounds and the



FIG 9—Case 2835. End result showing scars and full extension of knee.

ones that had extensive débridement and suture, healed readily without infection. The most fearsome type of infection was the gas gangrene and this was found present clinically in two and both clinically by culture, etc., in three others. All five cases had distinct subcutaneous crepitation, gangrene of the muscles, and the presence of the characteristic odor. Three of the five got well and they were the ones in which positive cultures were obtained. Other

types of organisms found in the infected cases were both aerobic and anaerobic staphylococci and the *B coli communis*

Complications None of the cases had a secondary hemorrhage

Seven (16.6 per cent) cases developed osteomyelitis. One of these was in a case that refused any surgical operation for seventeen days and only consented when there was an acute cellulitis around the wound. Two others were cases that were twenty-four hours old before being brought into hospital. The other four were in cases that had extensive laceration of soft parts and



FIG 10—Case 2835 End result showing scars and degree of knee flexion

comminution of the bones. All but one of the seven cases have been followed for at least one year, and five of the six are healed.

There were three cases of delayed union, two in cases of osteomyelitis. Of the two latter, union was firm in six months and in the other ten months after the accident. The third case had no real osteomyelitis, but had an ulcer of the site of fracture (just above the ankle). She had a bad fracture, bone ends hard to keep in alignment. Negative Wassermann. Had fibrous union and ulcer healed in four months. After five months, an injection of 15 cc of her own blood was made at the site of fracture and shortly after union became firm.

The following additional cases are reported to show good results obtained with different therapeutic measures.

CASE XII—569 G. D., laborer, twenty-four, run over by taxi. Compound comminuted fracture of upper end of tibia, wound and fracture communicating with knee-joint.

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Extensive débridement, cleansing of knee-joint with ether removing blood clots Knee-joint capsule sutured, skin sutured and circular cast from mid-thigh to toes Did well, primary union Five months after accident walks with slight limp, has full extension of knee, flexion to 90°.

CASE XIII—1725 M M, twenty, dressmaker Fell out of first-story window, sustaining a compound dislocation of left ankle, with fracture of external malleolus Laceration transverse across outer side of ankle 5½ inches long Wound débrided, irrigated with 1-5000 acriflavine Soft parts and skin sutured loosely, deformity corrected Plaster case with window Two days later some tension at both ends of wound and several sutures removed, allowing better drainage The case was also cut a few days later and leg and foot put up in a strong posterior moulded plaster splint She improved steadily, wound closed in less than a month, early motion begun and patient discharged in seven weeks Wore a brace for several months, the œdema gradually subsided, and ankle motion good One year after the accident, patient walks without limp Has slight œdema above wound, but none of foot Can stand all day and motion 100°

CASE XIV—2835 C S, thirty-five, laborer Laceration of thigh communicating with knee-joint, fracture of head of fibula Run over and dragged by truck Admitted to hospital with what appeared a contused superficial wound of leg Cleansed superficially and dry sterile dressing applied On second day after admission, temperature had risen to 102° and patient complained of severe pain in knee It was found swollen, subcutaneous crepitation present, evidences of gas gangrene Brought to operating room, two wide lateral incisions made into knee-joint from upper level of subcrural bursa down to tuberosities of tibia All necrotic muscle excised and knee-joint flushed out

Culture and guinea-pig inoculation for B Welch positive

Active Willems treatment for knee-joint instituted

Patient improved, wounds became clean, and finally closed Eight months after accident has perfect weight-bearing leg with normal knee motion

CASE XV—2854 H M, laborer, thirty-eight, slipped, and in falling kicked his right leg with left foot, sustaining a compound comminuted fracture of lower third of leg Soft parts débrided and several long loose fragments of tibia removed Wound cleansed and then sutured without drainage Posterior and lateral moulded splints applied Wound healed well except for slight superficial skin sloughing at lower angle No osteomyelitis Firm union in eight weeks Walks well seven months later

In closing, I wish to thank Dr R Hooker for the privilege of allowing me to compile and report these cases from files of the First Surgical Division of Bellevue Hospital.

SIMULTANEOUS DISLOCATION OF BOTH SHOULDER JOINTS*

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SIMULTANEOUS traumatic dislocations of both humeri form the subject matter of this paper, based exclusively upon the analytical study of all cases (fifty-eight in number) reported in the English, French and German literature from 1836 to 1923, supplemented by the clinical observation of one personal case. All the cases were (*a*) in location, bilateral, (*b*) in occurrence, simultaneous or immediately successive, and always caused by the same accident, (*c*) in nature, complete, (*d*) in causation, unquestionably traumatic. With one exception (32), the condition had never previously occurred in the same individual. In another case (28), both shoulders had been dislocated, the left six years, the right fourteen years previously. We have not attempted to discuss completely bilateral shoulder dislocations, only clinical facts and anatomical lesions reported in the original articles have been analyzed and summarized.

These dislocations differ in type, in etiology, in clinical manifestations and present various associated injuries of the articular and peri-articular tissues (osseous, nervous, vascular, etc.). Early and complete reduction, correction (operative or non-operative) of the co-existing complications, and institution of judicious after-treatment (massage, mechano-therapy, electricity, etc.) minimize, in fact almost always completely overcome, the anatomical deformity and the functional disability incident to shoulder dislocations.

We discarded cases like the following "Bilateral Dislocations of Shoulder with Marked Muscular Wasting" (60). The patient, a seventeen-year-old girl, an epileptic since birth, gave no history whatever of previous shoulder injury. Examination revealed an incomplete forward dislocation of both humeri with marked limitation of joint movements and evident wasting of the right deltoid and spinati. Skiagrams of both shoulders did not show any abnormality in the bone tissue. This case was eliminated because (*a*) it was an incomplete dislocation, (*b*) it was not traumatic in origin.

Habitual or recurrent dislocation is a condition of joint instability characterized by repeated, frequent and complete abnormal separation of contiguous joint-surfaces (65). It occurs upon slight provocation and is often consecutive to a traumatic dislocation. It may be associated with, or determined by (*a*) abnormal laxity or bagginess of the articular capsule, the resultant of a previous injury, (*b*) paralysis of one, of several, or of all the periarticular muscles. The tonicity of the periarticular muscles maintains in normal contact the glenoid cavity and the articular head of the humerus. (*c*) Non-union or a faulty union of fractures of the glenoid cavity, of the articular

* The numbers in the article refer to illustrative cases, for which see the bibliography.

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head of the humerus, etc ; (*d*) non-union or vicious union of a fracture of one or of both humeral tuberosities, (*e*) traumatic detachment from their insertion of one or more of the rotators of the humeral head When the external rotators are detached, with or without a lamella of bone, the action of the subscapularis predominates and a forward displacement of the head of the bone is easily effected. When the subscapularis is detached, with or without its osseous insertion, the action of the external rotators is no longer counterbalanced and backward dislocation of the humeral head may result, (*f*) traumatic separation of one or more of the upper epiphyses of the humerus, (*g*) anatomical defects of the glenoid cavity.

Allen (6) reports a case of "Simultaneous Dislocation of Both Shoulders" His patient, in the previous four years, had had four dislocations of the right shoulder and three of the left This case and similar cases (62, etc,) were rejected because (*a*) in their causation, trauma is not the determining etiological factor; (*b*) their frequent recurrence labels them habitual or recurrent dislocations (66), (*c*) they do not present the essential desideratum, that of being simultaneously bilateral; (*d*) they were associated with or consecutive to one or more of the lesions or conditions known to predispose to habitual dislocations

Incomplete (60), congenital (64, 65, 67) pathological (63) or spontaneous dislocations and those that were not simultaneously bilateral, are outside of the scope of this paper.

The fifty-nine cases herein considered present the following features (*a*) All were traumatic in causation and complete in nature (*b*) All were bilateral in location, though not always symmetrical (*c*) All were simultaneous in incidence, both shoulders being dislocated within a few minutes' interval Though not always due to the same immediate exciting factor, they were all caused by the same accident A passenger fell with others from the top of an omnibus as the vehicle overturned It was his belief that, in falling, he had dislocated one shoulder, and that his other shoulder had been dislocated by a friend falling on it (26) (*d*) All the joints affected were, previous to the dislocations, free from structural abnormalities, as far as can be determined by the text.

Bilateral shoulder dislocations occur in both sexes and at all periods of life Our series of collected cases show that they are more frequent in males than in females forty-seven males and eleven females My patient was a housewife fifty-six years old

The external violence which dislocates the humerus in adults, in children commonly gives rise to elbow dislocations, to fractures of the clavicle, to humeral epiphyseal separations Bilateral shoulder dislocations are very rare before the twentieth year The youngest patients in our series were a male nineteen years old (31) and a female twenty-one years old (24) In advanced life, shoulder dislocations are equally rare, the oldest patient being a female eighty-six years old (20) In eighteen cases the age incidence is not

stated, in the other cases, it was as follows Nineteen years, 1 case, 21 to 30 years, 6 cases, 30 to 40 years, 5 cases, 41 to 50 years, 11 cases, 51 to 60 years, 10 cases, 61 to 70 years, 5 cases, 71 to 80 years, 1 case, 86 years, 1 case

Bilateral simultaneous shoulder dislocations are either caused by external violence, direct or indirect, or by muscular action, acting singly (25) or co-jointly (18) Violent shocks or wrenches acting simultaneously on the two arms can produce simultaneous bilateral shoulder dislocations (45)

The mechanism of displacement can only be surmised (twenty-five cases)

(a) In cases not reported with adequate data Case 37 gave no history of previous dislocations and though both shoulders were considerably bruised and swollen, it remains a question of conjecture whether one or both dislocations were caused by the fit or the fall (b) In cases in which the mechanism of displacement is either not stated (dissecting (41) or post-mortem-room subjects (3, 45), or not described in detail In case 43, a woman fell three and one-half feet from a stepladder, with both arms extended over her head, in case 54, a woman fell forward head-first from the platform of a moving street car, in case 19, a chain springing upward caught the patient under the arm, threw him aloft, and he fell to the ground on the other arm (c) In cases in which the productive violence is complex in nature In case 39, a workman working in a pit, suddenly tapped water, the latter came with such force that he was washed down the dip a distance of sixty feet In case 40, a man (age not stated), oiling the fly-wheel of an engine in motion, entangled his shirt sleeve in the machinery He instantly grasped the spokes of the wheel, was whirled around several times, and then fell to the ground His clothing was torn to shreds Five minutes later, he was found in a state of deep syncope, his jaw and both shoulders were completely dislocated

In five cases (11, 21, 30, 55, 57) it is definitely reported that the dislocations were caused by violent muscular contractions incident to epileptic convulsions In case 12, puerperal convulsions were the causative factor In five other cases muscular action was the provocative force In case 1, the displacement occurred during unusually violent efforts to control a struggling animal, in case 6, the patient, raising over his head a calf, was forced, by the animal's struggles, to let it fall backward In case 14, the displacement followed the contraction of the great pectoral and latissimus-dorsi muscles of each side The patient, standing insecurely on the edge of a loaded coal truck, attempted to maintain his balance by resting one hand on the coal and the other on the arched end of the wagon His feet slipped, and, while endeavoring by a sudden effort to save himself from a fall, he "felt something give" at his shoulders On rising, he was unable to use either arm "When he slipped, the weight of the trunk fell, in part at least, on the outspread arms, in the sudden effort to support the trunk, the two pairs of muscles just mentioned were probably among the first to contract Acting simultaneously, the glenoid cavities being the fulcra, their normal effect is to press the arms to the side On the present occasion, however, the hands became the fulcra, being firmly supported on the wagon, and the head of each humerus was jerked inward by

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muscular contraction at a moment when the bones were in a position favorable to the displacement."

The remaining cases were caused by external violence, the causative force being applied either directly to the shoulder, or transmitted indirectly to the articulation, as by a fall upon the outstretched hands (17), upon the extended elbows (23).

In the following three cases, the injury can be attributed to direct violence. In case 46, the patient, while conveying a barrel down cellar steps, slipped and fell upon his abdomen and right side. He was caught between the steps and the barrel, the latter passing over his back. In case 24, the patient, during a heavy storm, was walking along a high stone wall. The wall suddenly crumbled, and striking the patient's right shoulder, threw her forcibly to the ground directly on her left shoulder, and buried her in the débris. In case 31, a miner pushed a heavy truck against a prop supporting the roof of a coal pit; roof gave way and fell on the patient's back, burying him in a heap of rubbish. He was finally pulled out by the right arm.

Examples of dislocations due to indirect violence follow. In case 5, patient was thrown from his cart and fell head downward, alighting upon his hands. In case 8, a porter, to receive a sack of grain upon his back, leaned forward and held on to the rear of his wagon with both hands. While still holding fast to the wagon, the sack fell heavily on the back of his neck and violently forced the trunk of his body forward. In case 45, the forcible elevation and traction of the arms caused the head of the humerus to impinge on the lower border of the capsule, thus favoring its exit. In case 16, patient, working upon a scaffold, lost his footing and fell, striking the ground with both elbows at the same time. In case 17, the patient fell from his carriage, his arms extended in front of him; the force of the concussion was received upon his hands. In case 22, the forcible elevation of the arms against the body by a fall through a narrow trapdoor, thrust both humeral heads out of their sockets. In case 29, patient fell from a tree, a distance of forty feet, on his outstretched arms. In case 34, patient fell into the water. He was pulled into a neighboring tug by traction on his extended arms and immediately felt severe pain in both shoulders and arms; both humeri were dislocated. In case 36, a stout woman, tripping over a carpet, fell forcibly forward, the weight of her body being received on both outstretched forearms and elbows. My patient fell from a ladder, striking the ground with both hands, arms and forearms being fully extended.

From the standpoint of prognosis and treatment, shoulder dislocations can be classified into recent and old. Dislocations become old through faulty diagnosis, faulty attempts at reduction and often through surgical neglect. In old dislocations, the articulation itself and the peri-articular tissues are the seat of structural changes. The anatomical relations of the head of the humerus and of the glenoid cavity are altered. The glenoid fossa may be partly or wholly obliterated by cicatricial tissue, calcified cartilage, etc (52). Case 41 presented fully developed false shoulder-joints. In old dislocations, the

various bloodless manipulative and other non-operative procedures are often, owing to these changes, powerless to effect either an anatomical or a functional cure. There were eight old dislocations varying in age from six weeks (42), nine and one-half weeks (29) to several years (21). Cases 12, 14, 23, 52 and 58 were of several months' duration.

All cases not referred to before (dissecting- and autopsy-room cases excluded), were recent in nature. My case (59) was seen and reduced two hours after its occurrence.

There are several anatomical classifications in current use. Lack of uniformity in nomenclature is regrettable, is misleading. So as not to vitiate the accuracy of this analytical study, we have, in each case, quoted the reporter's words. In thirteen cases (1, 3, 4, 5, 11, 12, 25, 26, 27, 30, 40, 41, 53) the anatomical type of displacement is not stated or is not precisely described. The exact anatomical relations of the displaced head are either not given or unqualified expressions as "backward" or "downward" displacement are used.

In thirty-six cases both dislocations were of the same anatomical type, and were symmetrical or closely symmetrical. In case 56, a double "luxatio erecta," the humeri were fixed in vertical elevation, both glenoid fossæ were empty, both shoulders presented a distinct hollow beneath the acromion process, and in each axilla the humeral head could be palpated as a hard, globular mass. In a bilateral subclavicular dislocation (13), each humeral head was lying against the second and third ribs, just below the clavicle. In case 34, a bilateral intra-coracoid dislocation, the head of each humerus could be felt to the inner side of its corresponding coracoid process, the inward displacement was more marked on the left side. Case 57, belongs to the sub-acromial and case 18 to the supracoracoid type (verified at autopsy). Case 55 was a bilateral and symmetrical subspinous dislocation, each humeral head being palpable beneath the spine of its corresponding scapula.

Different reporters use unlike terms to designate like displacements. The description given in the case reports, does not enable one to differentiate subglenoid (43 and 52) dislocations from those termed axillary. Nevertheless, we use here the nomenclature found in the original publications. In two cases (36, 41), the reporters state that the head of the bone was displaced into the axilla. In my case, the head of the bone was palpable on each side immediately below the coracoid process of the scapula.

In six cases the dislocations were bilateral and in the same general direction, but dissimilar in anatomical type. A subglenoid and a subcoracoid dislocation were present in three cases (2, 36, 47). In case 7, the left humerus was displaced into the axilla, the right under the clavicle. In case 33, the head of the left humerus was immediately below the subcoracoid process, the head of the right humerus had ruptured the muscle in its path and was subclavicular in location. In case 9, the left humeral head rested on the anterior margin of the lower border of the scapula just below the glenoid cavity, and the right humeral head was prescapular, lying between the anterior

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surface of the bone and the subscapularis muscle. In case 15, the left humerus was below the coracoid process and on the right side, the head of the humerus could be felt upon the dorsum of the scapula, a subspinous dislocation. Case 20 presented a subcoracoid and an intra-coracoid dislocation.

Very little demonstrated pathology is recorded in the case-reports because (a) these dislocations, unless complicated by great shock (56), associated injuries (3), senility, marasmus (20), etc., are not fatal and therefore rarely come to the autopsy table; (b) unless irreducible by bloodless methods, they do not reach the operating-table. To conform to the plan outlined at the beginning of the article, we record only the pathology actually demonstrated and reported in our series of cases.

In shoulder dislocations, the articular and peri-articular soft tissues (20) are contused, lacerated and infiltrated with blood. The synovial fluid is blood-tinged and increased in amount (13). A tear of the joint capsule (9, 13, 20), through which the head of the bone has escaped from its normal habitat, is present in all cases. The greater frequency of forward and downward displacements is due to the fact that the capsular tear is usually on its anterior and inner portion (20), at its lower aspect (56). The capsule at its lower portion is not reenforced by any ligament or muscle. The capsular tear and the untorn portion of the joint capsule control, determine in a large measure, the type of displacement. In some cases there is recorded a detachment of the subscapularis, the teres minor, the supra- and infra-spinatus muscles, singly or together, from their insertion. At times a bony fragment consisting of the outer shell or cortical layer of the humerus is torn off with these muscles. Fractures of either the greater or lesser tuberosities are not uncommon. They vary in extent, may constitute a formidable obstacle to reduction and predispose to relaxation.

The diagnosis of these fractures is difficult (9) because the detached fragment often cannot be felt and crepitus often cannot be elicited. The only certain means of diagnosis is by radiogram; but one must bear in mind that a torn subdeltoid bursa full of clotted blood may, by throwing a shadow, simulate a bone-fragment.

The following associated injuries are recorded. Bilateral fracture and detachment of the greater tuberosities (9, 58), fracture of the right coracoid process near its base (9), compression of the axillary nerves and vessels (56), contusions of various portions of the body (31, 43). In case 46, the fracture of the lower end of the right radius is to be considered a related injury. As distal, though not related, associated injuries, the following are reported: Skull fracture (9), fracture of the lower third of the femur (35), compound fracture of the middle of the left leg (39), complete (bilateral) dislocation of the jaw (40), gangrene of right foot (52). Fracture of the surgical neck of the humerus was not present in a single case. It is not rare in unilateral dislocations.

There are symptoms (pain (5, 23, 45); loss of function (21, 54); rigidity (12); "patient is unable to use his arms" (48, 58); in my case the loss of

function and joint-rigidity were complete) common to all shoulder dislocations. There are symptoms that occur only in certain types of displacement: the location of the humeral head, the position of the elbow, etc., differ in the various anatomical forms. In complicated cases, one finds, in addition, the alterations of function, of structure and of contour due to the co-existing injuries.

In all bilateral shoulder dislocations, note the direction of the axis of each humerus, note the relations of the bony landmarks of the shoulder region, note the extent of functional impairment and the degree or range of joint-mobility. Any deviation from the normal is symptomatic of underlying pathology.

In unilateral dislocations, to establish a diagnosis, one compares the injured shoulder with the unaffected. In bilateral dislocations, the clinician cannot avail himself of this aid as both shoulders are, most always, symmetrically deformed, the measurements of both sides often not differing half an inch (31), at times they are similar (54). In my case, the measurements of both arms were practically identical. Secure full exposure of both shoulders by divesting upper portion of chest of all unnecessary clothing.

The rotundity of the shoulder depends partly on the head of the humerus being in its proper place and partly on the integrity of the deltoid muscle. Therefore, in all inward, downward or backward displacements of the head of the humerus, the normal contour of the shoulder is lost and there is present a double deformity: a distinct flattening of the shoulder region, due to the absence of the head of the bone from its normal place, and an abnormal bulging due to the presence of the displaced head in its new habitat. In dislocations, the deltoid slopes straight from the acromion, or sinks in, having an indented appearance at its insertion. An empty glenoid cavity (23, 54) and abduction of the arm, accompany all shoulder dislocations. "The roundness of the shoulder was quite gone" (15). "Both shoulders were flattened and both arms were abducted from the chest wall" (45, 54). In my case, though patient was obese, the emptiness of the glenoid cavities could be demonstrated and the flattening of both shoulders was typical.

In all shoulder dislocations, the head of the bone can, by painstaking inspection and palpation, invariably be detected in an abnormal location. "The head of the humerus could be readily felt under the pectoral muscle" (2). "Head of bone could be readily felt upon the dorsum of the scapula" (15). "In each axillary space, the head of the corresponding humerus could be palpated" (22, 24). In case 34, the head of the right humerus was below and a little to the inner side of the coracoid process, the head of the left humerus lay farther inward. In cases 23 and 40, and in my case, the humeral heads could be felt under the coracoid processes, rotation of either arm caused rolling of the corresponding ball-shaped head.

In all bilateral dislocations of the humerus there is a distinct hollow or hiatus beneath the acromion process (2, 41), this hiatus being less noticeable in subacromial dislocations (57).

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In old and recent dislocations, the deformity is so characteristic that the diagnosis is often made by inspection and palpation. In obese and muscular individuals, exact diagnosis is more difficult "There was a hiatus under each acromion, but in consequence of the mass of adipose tissue it was not possible to feel the head of the humerus in the axillary space" (41).

In all cases, it is advisable to have both shoulders radiographed. The radiograms serve as a record, as a guide, they often clear up many unsuspected conditions (54, 58), and establish the diagnosis upon an undisputable basis (52) "The head is displaced downward, it is entirely below the glenoid cavity, and is away from the thoracic wall" (56) In my case, on both sides, the radiograms showed distinctly the integrity of the acromion, of the coracoid process, of the clavicle, of the head and anatomical and surgical necks of the humerus The acromio-clavicular articulations were normal. Each humeral head was away from the chest wall, was away from the glenoid fossa and immediately below the coracoid process. Radiograms show the exact location of the humeral heads, reveal the presence or absence of complicating osseous lesions fractures of the humerus, of the surgical neck and coracoid process of the scapula They remove doubts from the clinician's mind Stereoscopic pictures are less liable to misinterpretation

Complicating injuries of the nervous system are evidenced by motor, sensory and trophic disturbances Some of these nervous lesions are irremediable, others, such as contusion, compression, stretching and division (partial or complete) give, under appropriate treatment, a hopeful prognosis At the first examination, one should exclude an involvement of the circumflex or other nerves, sometimes, the nerve involvement affects all the muscles of the upper extremity. "One month after reduction of the dislocations, patient was unable, owing to a partial paralysis of the deltoid, to completely elevate left arm" (45) In non-reduced cases, the nerves may be compressed by scar-tissue By taking the pulse on each side, one is enabled to ascertain the presence or absence of important vascular injuries

Including my personal case, we analyzed fifty-nine cases Six cases, for various reasons, were untreated In case 3, patient was dead at time of diagnosis. Case 9 died from a skull fracture five hours after being brought to the hospital In case 13, patient died from a broncho-pneumonia shortly after admission to hospital and before the dislocations were reduced. Case 18 was an autopsy-room subject Case 41 was a dissecting-room subject In case 21, for some reason not stated, no attempt at reduction was made To these may be added a case of double luxatio erecta (56), the dislocations were reduced, but patient died of shock from the associated injuries There were eight old dislocations, their treatment and the results obtained are discussed at the close of the article

Recent dislocations are reducible or irreducible Primary irreducibility is usually due to some complication Associated fractures, detachment of either humeral tuberosity, especially if the detached fragments lie in the glen-

oid cavity, hinder reduction, predispose to recurrence The indication to suture or nail the detached fragment to its normal place may prevail

Recent dislocations call for immediate reduction At the outset, let us emphasize that the treatment of choice is non-operative In the treatment of shoulder dislocations, operation is a last resort Only two recent dislocations were subjected to operation In case 34, the dislocation on the right side was reduced with the aid of ether anæsthesia without much difficulty All manipulative efforts failed to reduce the one on the left side On the following day the joint-cavity and the left humeral head were exposed by an anterior incision The humeral neck was crossed above on its outer side by the untorn tendon of the subscapularis

Anæsthesia facilitates reduction, it abolishes pain, it overcomes muscular spasm and the patient's resistance, with its aid, one can by gentle manipulation gradually break up adhesions opposing reduction (36) It is especially serviceable in muscular individuals (35)

In five cases (8, 28, 38, 53, 54) in which reduction was obtained by non-operative methods, the text makes no reference of the use of anæsthesia In nineteen cases (1, 2, 4, 5, 7, etc), non-operative methods, unaided by anæsthesia, successfully effected reduction In case 33, the left humerus was reduced without anæsthesia, the right humerus, with anæsthesia In twelve cases, to effect reduction, non-operative methods had to be supplemented by general anæsthesia (19, 20, 45, chloroform, 36, 43, ether, etc) In my case, to secure reduction, the patient was etherized

In every recent case but one (34), in which non-operative methods were employed, the head of the bone was successfully replaced in its normal habitat At times, one side is reduced easily, but to effect reduction of the opposite side, difficulty is experienced (39, 41), anæsthesia may be required (33, 36) In many cases, the clinicians noted the occurrence of a peculiar jerk, of a distinct audible snap upon return of the bone to its socket (1, 2, 4, 5, 15, 20, 46, 51) Instant relief from pain often follows reduction In seven cases (6, 8, 25, 27, 30, 47, 57), it is not stated that attempts at reduction were made

Among the non-operative methods, Mothe's method was used in one case (20), Kocher's method in ten cases (22, 32, 45, 46, 49, 50, 51, 53, 54, 59) In the remaining twenty-seven cases reduction was effected by various bloodless manipulative procedures supplemented by extension and counter-extension (1, 5, 24, 31, 41, 55) The extension is made by the operator, his assistants, weights or pulleys, counter-extension, by axillary pads, by heel in the axilla (2, 4, 7, 15, 16) In fifteen cases the method employed to secure reduction is not described in detail (10, 11, 17, 19, 26, 28, 33, 35, 36, 38, 39, 40, 43, 48, 56)

After reduction, the shoulder must be immobilized long enough to allow the repair of the capsular tear It is also imperative that passive and active motion, and massage, be instituted early enough to avoid ankylosis

The treatment of old dislocations requires great care and individualization Owing to the close interrelation of treatment and results, it is best that they

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be discussed together. There were eight old dislocations of from six weeks to several years' standing. In old dislocations, the difficulty of reduction is due to various factors. Cicatrization and contraction of the capsular tear (52), inflammatory adhesions binding the head of the humerus to the surrounding structures, obliteration of the glenoid cavity, adhesion of the joint-capsule to the periphery or to the entire glenoid fossa, interposition of tendon or muscle, etc.

Some old dislocations are amenable to bloodless manipulative procedures, others require operative aid. Though not always successful, the former should always be first attempted, successful bloodless manipulative methods secure better functional and anatomical results than operative treatment. When manipulation, traction by pulleys, etc., supplemented by anæsthesia, fail to obtain reduction, operation, if not contra-indicated, is to be performed. Arthrotomy permits direct inspection of the articulation and of the contiguous structures. It enables the operator to determine, to remove obstacles to reduction. "The tendon of the triceps prevented the head of the bone from re-ascending and slipping back into its normal place (56)."

Unreduced dislocations are accompanied by deformity and disability, varying in degree, but permanently impairing the earning capacity of a hand-worker. Operative treatment has a very low mortality, almost nil, and though final results are not always perfect, pain and circulatory disturbances are relieved. There follows a very fair restoration of function.

In elderly people, fracture of the shaft of the humerus has resulted from forcible attempts at reduction of old shoulder dislocations. During careful (author's words) attempts at reduction of a dislocation of several months' standing, the humerus was fractured immediately above the insertion of the deltoid muscle (52). Atrophy, adhesions of the surrounding muscles and soft parts and adhesions of the torn joint-capsule, all these tend to make, at times, reduction by manipulation difficult, impossible, or extremely dangerous. In case 12, seven months after the accident, reduction was secured by bloodless methods. In case 14, reduction by pulleys and counter-extension was half-heartedly attempted, was unsuccessful. The case was abandoned to nature; deformity and disability persisted. Case 21 was untreated. Case 58 was of six months' standing. Attempts (Kocher and others) at reduction under anæsthesia were unsuccessful. Patient being sixty-five years old, operation was not advised. Case was treated by massage, active and passive motion, with indifferent results. In case 23, though the humeral heads had remained out of their sockets twelve weeks, reduction was effected by manipulative methods (elevation of the arms, etc.,) with the aid of anæsthesia. Joint-motion was not fully recovered. On right side, arm could be abducted to the horizontal, on left side functional recovery was more incomplete. In case 42, the value of judicious persistency is demonstrated. One month after the accident two attempts, two days apart, were made under anæsthesia to reduce the dislocation with the aid of pulleys. They were unsuccessful. Two weeks later another surgeon effected reduction by the aid of pulleys.

Resort to a cutting operation when convinced of the futility of further use of non-operative procedures. In the young, reduction is more easily effected, presents less difficulty than in adults, and bloody intervention is rarely justified. In case 52, during attempts at reduction of the dislocation on the one side, the humerus having been fractured above the insertion of the deltoid, the joint was opened. Owing to the partial obliteration of the glenoid fossa by cicatricial tissue and by osteophytic outgrowths, reduction was difficult. The glenoid cavity was cleaned out, and cicatricial bands opposing reduction were cut. The head of the bone was replaced in its normal position. Three months later, the arms could be abducted to the horizontal. The remaining case 29 was operated on by Sir Joseph Lister nine and one-half weeks after the accident. Each humerus was protruded through the incision and all the rotators divided at their insertion, at the second attempt "the pulleys drew the bone into the proper position." Two months after discharge, patient came to the hospital for inspection, and it was seen that arms could be raised to a right angle with only slight movement of the scapula, rotation was much improved. Patient stated that he could do hard agricultural work as well as ever.

The incision giving access to the articulation may be made along the posterior or the anterior axillary fold. All cicatricial bands impeding reduction are cut, muscles preventing reduction are divided and subsequently sutured. The head of the bone being replaced into the joint-capsule, the latter is closed as completely as possible.

In the recent dislocations, the ultimate results are recorded in some cases, not mentioned (twenty-eight cases) in others. In eight cases (7, 10, 22, 24, 40, 48, 57, 59) recovery was complete. In some of the remaining cases, the late results are reported as follows: "Eight weeks after accident patient was quite well" (31), "seven weeks after accident patient was able to do light labor" (33), "patient suffers from chronic rheumatism, function has been slow in returning, it is not yet complete" (36), "five weeks after injury arm could be elevated to horizontal position" (51), etc.

The prognosis in bilateral shoulder dislocations is influenced by many factors, chief among which should be mentioned, age of the patient and of the dislocation, the patient's occupation, the associated injuries and the treatment instituted. As a rule, the older the patient (36), the longer the period required for recovery. As to the age of the luxation, it is agreed that dislocations call for immediate reduction. Sequelæ are thereby forestalled, nothing is gained by delay. Convalescence is longer in handworkers than in intellectuals, delicate hand movements are late in returning. Associated injuries require appropriate treatment. In some cases full function is not restored before the detached muscles or tuberosities are permanently fixed in their normal place.

Bloodless manipulative methods, supplemented by electro-, mechano- and hydro-therapy give the best results. The two dislocations, right and left, are reduced separately, usually by the same method and at the same sitting. The duration of immobilization varies in different cases. 12 days (31), 5

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weeks (36), etc. We are of the opinion that most clinicians err in prolonging complete immobilization beyond two weeks. About the tenth day gentle passive motion and massage and electrical treatment should be instituted.

After an arthrotomy and division of extensive adhesions, even though the bone is replaced to its normal position, some joint-stiffness is to be expected. This is generally compensated for by a movable scapula. The restoration of the rotundity of the shoulder and the absolute relief of pain give much satisfaction to the patient.

After reduction of the dislocations both shoulders are immobilized during the period of repair, the arms fixed in front of the chest by adhesive plaster, bandages, etc., for from two to three weeks. The patient is practically helpless, he cannot feed himself, he cannot dress himself, he cannot attend to many of his other needs, he must be provided with an attendant.

BIBLIOGRAPHY

- ¹ Fischer. Preussische Medizinische Zeitung, 1836, p. 344. New York Journal of Medicine, 1857, vol. III, p. 301. Reported by Van Buren.
- ² Coote. Dislocation of Both Humeri from a Fall. Lancet, London, 1846, vol. I, p. 532.
- ³ Cooper, Sir Astley. Lancet, London, 1852, vol. I, p. 357. Reported by Smith.
- ⁴ Smith, W. H. Lancet, London, 1852, vol. I, p. 356.
- ⁵ Thompson, R. Simultaneous Displacement of Both Humeri. Lancet, London, 1852, vol. I, p. 383.
- ⁶ Landor. On a Case of Simultaneous Displacement of Both Humeri. Lancet, London, 1852, vol. I, p. 356. Reported by W. H. Smith.
- ⁷ Webber, Chas. S. Dislocation of Both Humeri, with Fracture of the Femur. Lancet, London, 1852, vol. I, p. 398.
- ⁸ Sanson, N. Y. J. M., 1857, vol. III, p. 302. Reported by Van Buren.
- ⁹ Van Buren, Wm. H. Simultaneous Dislocation of Both Shoulder Joints. New York Journ. of Med., 1857, vol. III, p. 297.
- ¹⁰ Geddings. New York Journ. of Med., 1857, vol. III, pp. 301-302.
- ¹¹ Ballingall. New York Journ. of Med., 1857, vol. III, p. 302.
- ¹² Smith, Nathan. New York Journ. of Med., 1857, vol. III, p. 302. Reported by Van Buren.
- ¹³ Gross, S. D. Med. and Surg. Reporter, Phila., 1864, vol. XI, p. 82. Reported by Dr. R. G. Ludlow.
- ¹⁴ Couper, A. Simultaneous Dislocation of Both Shoulders in an Adult. Unreduced at the End of Thirteen Weeks—Ultimate Recovery of Perfect Mobility and Strength. Med. Times and Gaz., 1867, vol. II, p. 432.
- ¹⁵ Pearse, G. E. L. Simultaneous Dislocation of Both Shoulder-joints. Lancet, London, 1874, vol. I, p. 620.
- ¹⁶ Davidson. Double Dislocation of the Shoulder. Lancet, London, 1875, vol. II, p. 117.
- ¹⁷ Pardee, E. L., and Arnold, G. C. Simultaneous Dislocation of Both Shoulders. Hamilton on Fractures and Dislocations, 1891, p. 594.
- ¹⁸ Albert (d'Inspruk). Wiener med. Wchnschr., 1886, No. 38, p. 1284. Reported by Zesas.
- ¹⁹ Caskie. Dislocation of Both Humeri into the Axillæ. British Med. Journ., 1881, vol. II, p. 854.
- ²⁰ Gueterbock, Paul. Ueber doppelseitige Oberarmverrenkung. Berliner klin. Wchnschr., 1885, pp. 346-348.
- ²¹ Fraenkel, B. Ein Mann mit doppelseitiger symmetrischer Luxation des Humerus nach vorne. Verhand. d. Berl. med. Gesellsch., 1881-1882, vol. XIII, p. 150.

- ²² Woerner, A Doppelseitige traumatische Oberarmluxation Beitr z klin Chir, 1886, vol 11, p 396
- ²³ Pontoni Wiener med Wchnschr, 1886, p 1284. Reported by Zesas
- ²⁴ Zenker, W Ueber doppelseitige Oberarmverrenkung Berl klin Wchnschr, 1885, vol xxii, p 418
- ²⁵ Holmes Double Dislocation of the Shoulders Lancet, London, 1890, vol 1, p 94
Reported by Gant
- ²⁶ Gant Double Dislocation of the Shoulders Lancet, London, 1890, vol 1, p 94
- ²⁷ Hamilton Lancet, London, 1890, vol 1, p 94 Cited by Gant
- ²⁸ Milne, Alex Double Dislocation of the Shoulders Lancet, London, 1890, vol 1, p 400
- ^{29, 30} Lister, Sir Joseph Lancet, London, 1890, vol 1, pp 1-4
- ³¹ Yeoman, Stanley Dislocation of Both Shoulders Lancet, London, 1891, vol 11, p 983
- ³² Szczypiorski, S Luxation simultanee des deux épaules Gaz d hôp de Paris, 1892, vol lxxv, p 728
- ³³ O'Sullivan, Patrick T Dislocation of Both Shoulders Brit Med Journ, 1893, vol 11, p 945
- ³⁴ Stimson Simultaneous Dislocation of Both Shoulders New York Med Journ, 1891, vol liii, p 311
- ³⁵ Oldacres Simultaneous Dislocation of Both Shoulders Brit Med Journ, 1895, vol 11, p 1162
- ³⁶ Powers, Charles A Simultaneous Dislocation of Both Shoulders New York Med Journ., 1894, vol lix, p 689
- ³⁷ Haslip Dislocation of Both Shoulder-joints Lancet, London, 1896, vol 11, p 603
- ³⁸ McDougall, Rd Dislocation of Both Shoulders Brit Med Journ, 1896, vol 1, p 383
- ³⁹ Steele, Jon Simultaneous Dislocation of Both Shoulders Brit Med Journ, 1896, vol 1, p 656
- ⁴⁰ Hartill, John T Simultaneous Dislocation of Both Shoulders Brit Med Journ, 1896, vol 1, p 1199
- ⁴¹ Stuart, T P Anderson Brit Med Journ, 1896, vol 1, p 1385
- ⁴² Hennequin Bulletins et Memoires de la Societe de chirurgie de Paris, 1898, vol xxiv, pp 967-972
- ⁴³ Merritt, S Virgil Simultaneous Dislocation of Both Shoulders Phila. Med Journ, 1900, vol vi, p 4.
- ⁴⁴ Lankester, Howard Synchronous Dislocation of the Humeri (Subglenoid) St Paul Med Journ, 1901, vol iii, pp 177-178
- ⁴⁵ Stewart, Acheson Simultaneous Subcoracoid Dislocation of Both Shoulders Pennsylv Med Journ, 1903-4, vol vii, p 601
- ⁴⁶ Horand, Rene Luxation des deux epaules Lyon med, 1905, vol cv, p 858
- ⁴⁷ Hunter, D G A Case of Simultaneous Dislocation of Both Shoulders British Med Journ, 1907, vol 11, p 20
- ⁴⁸ Anglada, J Luxations doubles simultanees scapulo-humerales Arch gen de chir, Paris, 1908, vol 11, pp 588-600
- ^{49, 50, 51, 52, 53} Lindemann, August Ueber doppelseitige traumatische Schultergelenkluxationen Deutsche Zeitschrift fuer Chirurgie, 1909, vol cii, p 561
- ⁵⁴ Mayet Luxation simultanee des deux épaules Paris chirurg, 1913, vol v, p 1087
- ⁵⁵ Walther, Ch. Luxation bilaterale de l'épaule en arriere Bulletins et Memoires de la Societe de chirurgie de Paris, 1918, vol xlv, 1, pp, 817-819
- ⁵⁶ Murard Un cas de "luxatio erecta" de l'épaule, double et symétrique Revue d'orthop, Paris, 1920, vol vii, pp 423-429
- ⁵⁷ Costantini Luxation sous-acromiale bilaterale par action musculaire (epilepsie) Presse méd, Paris, 1922, vol xxx, p 48
- ⁵⁸ Pilz, Wilhelm Ueber doppelseitige traumatische Schulterverrenkungen Arch f klin Chir, Berlin, 1923, vol cxxiii, pp 400-408
- ⁵⁹ Heineck, Aimé Paul Personal Case

SIMULTANEOUS DISLOCATION OF BOTH SHOULDER JOINTS

- ⁶⁰ Sargent, P W G Case of Bilateral Dislocation of Shoulder with Marked Muscular Wasting Proceedings of the Royal Society of Medicine, London, 1908-9, vol 11, 2, Neurological Section, p 37
- ⁶¹ Allen Simultaneous Dislocation of Both Humeri Lancet, London, 1890, vol 11, p 339
- ⁶² Moore Dislocation of Both Humeri Med Record, N Y, 1880, vol xviii, p 97
- ⁶³ Quénu Double luxation ancienne de l'épaule Soc anat de Paris, 1877, vol 111, p 417
- ⁶⁴ Harvey A Case of Congenital Dislocation of the Shoulders Trans Royal Acad Med of Ireland, 1910, vol xxviii, p 383
- ⁶⁵ Huntley Congenital Dislocation of the Shoulder-joint J A M A, 1910, vol 1v, p 2213
- ⁶⁶ Greenwood Displacement of Both Humeri Lancet, London, 1852, vol 1, p 422
- ⁶⁷ Le Fort Luxation des deux épaules Bull de la Soc de chir, 1888, vol xiv, p 60

BOOK REVIEW

A SYSTEM OF SURGERY Edited by C C CHOYCE, F R C S, Director of the Surgical Unit, University College, London, and J MARTIN BEATTIE, M D., Professor of Bacteriology, University of Liverpool In three volumes Second edition, vol i, pp 1013, vol ii, pp 1057, vol iii, pp 1176 New York, Paul B Hoeber, 1923

This work was designed to present to the profession and advanced students a sound and comprehensive treatise on British theory and practice in surgery The second edition was delayed by the intervention of the Great War, but has now been brought up to date by thorough revision and the rewriting of a number of the articles Among these articles are very complete sections on X-ray diagnosis, fractures, tetanus, and orthopædic surgery by prominent authors One hundred and fifty new illustrations, including some fifty new plates, have been added.

The three volumes are compact in arrangement and convenient in size, inviting to easy and frequent use The illustrations are characteristic and often of excellent diagnostic value. Selected bibliographies are appended to most of the articles

Volume I is devoted to the general consideration of surgery, including surgical pathology Several articles covering the latter subject are contributed by the co-editor, Professor Beattie

Volume II contains articles on regional surgery, including the breast, gastro-intestinal tract, and urinary tract The section on the breast, by Handley, is very complete, and presents that author's arguments as to the spread of cancer, and his practice as to operation Sherren, Miles, Grey, Turner, Clogg, and others give well-illustrated articles on gastro-intestinal surgery which are also very complete in the consideration of diagnosis

Volume III deals with the more special departments of surgery The female genital tract is concisely treated by Bonney in limited space The ear, nose, throat, neck and respiratory system are here presented The nervous system is attractively covered at length by Sherren and Trotter Bones and joints are very fully treated by Choyce Fractures and orthopædic surgery, as well as other departments of surgery, are presented at moderate length

Some portions of the work are less attractive by reason of the free use of fine print to save space Aside from this, the work makes a good impression, is complete in its scope, and practical in its presentation It fitly represents British present-day surgery

RICHARD W WESTBROOK

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Remittances for Subscriptions and Advertising and all business communications should be addressed to the

ANNALS of SURGERY

227-231 S 6th Street

Philadelphia, Penna.

ANNALS of SURGERY

VOL LXXIX

JUNE, 1924

No 6

THE PRE-OPERATIVE PREPARATION OF HANDICAPPED SURGICAL PATIENTS

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THE recent successful results following operations on patients handicapped with such conditions as diabetes, gastric retention, obesity, exophthalmic goitre, obstructive jaundice and urinary retention, are a great credit to the combined pre-operative treatment of internist and surgeon. Not more than three years ago, patients handicapped thus, were regarded as potentially grave surgical risks, and so accepted by the surgeon without due consideration of the possibilities of pre-operative preparation. The patient with diabetes, therefore, was denied operation, or if operation seemed unavoidable, the risk was from 8 to 10 per cent. Likewise little effort was made to clean an obstructed stomach until the morning of the operation. Immediate ligation of one or both superior thyroid arteries in many instances was the only preparation that the patient with exophthalmic goitre received. In cases of obstructive jaundice and of retention of urine resulting from hypertrophied prostate, immediate operation was often advised. Because of lack of preparation many patients with obstructive jaundice bled to death and the patient with retention of urine, sometimes went into uremic coma from the sudden decompression of the bladder. To-day all such patients are carefully prepared before operation by the internist and the surgeon, and operation is not performed until the patient is in the best possible condition for it.

Pre-operative Procedures The patient with diabetes is hospitalized under the care of the internist. A weighed diet is given, in which carbohydrates and fats are restricted until the urine becomes sugar and acetone free. It is sometimes advisable to assist in the assimilation of a larger amount of carbohydrate than the patient can take care of normally, by the aid of insulin.

The patient with gastric retention is under observation until the washings from his stomach are reported free from food particles. To accomplish this it may be necessary to wash the stomach two or three times a day, giving the patient a liquid diet, and maintaining the body fluids by means of proctoclysis or by the subcutaneous injection of a normal salt or a 2 per cent glucose solution. If the obstruction is due to cancer of the pylorus, besides the pre-operative cleansing, preliminary gastro-enterostomy may be necessary as

advocated by Crile and Lihenthal, this is performed easily under local anæsthesia with very little risk, and ten to fourteen days later, when the patient's general condition has improved, as a result of being able to eat and assimilate food, he is in infinitely better condition for resection of the tumor than in the beginning

The obese patient has been recognized as a grave surgical risk for years, not only because of the mechanical difficulty of abdominal operation, but because he is exceedingly prone to unfortunate complications such as fat embolism and infection. A high surgical risk in these patients may often be cut in half by placing the patient on a diet sufficiently low in calories to permit a loss of from 10 to 15 per cent of body weight before operation. Keeping patients in bed for a week or ten days during this period of weight reduction, tends to assist in relaxing the abdominal wall.

The pre-operative treatment of patients with goitre depends much on the type of case, the exact clinical and physiologic condition, and the complications in each case. In cases of hyperthyroidism it is essential to distinguish the exophthalmic goitres from the hyperfunctioning adenomatous goitres. The administration of Lugol's solution to patients with exophthalmic goitre during the last two years at the Mayo Clinic seems to have reduced the post-operative mortality approximately 2 per cent, and the total mortality, including pre-operative and post-operative mortality from 3 to 4 per cent.

During the last two years approximately 100 patients with intense obstructive jaundice have been operated on, and only two have had severe post-operative hemorrhage. All of the jaundiced patients had had a daily intravenous injection of 5 cc of a 10 per cent solution of calcium chlorid for a period of three days before operation. Also their body fluids and carbohydrate intake had been increased daily by large quantities of fluids by mouth, and glucose solution by proctoclysis.

In the last two or three years patients with retention of urine resulting from hypertrophied prostate have been much more carefully prepared than formerly. It is true that in certain instances the bladder was drained immediately by means of suprapubic cystostomy, and yet many of the patients died from uremia and infection. Hunt and Bumpus have been able gradually to relieve such obstruction by means of a water pressure apparatus. The apparatus is raised to a level that allows the bladder to empty through an indwelling urethral catheter, at the rate of not more than 1 or 2 cc in an hour, from twelve to twenty-four hours being required completely to empty the bladder. Thus the possibility is eliminated of congesting the kidneys, which may occur when back pressure, resulting from urinary obstruction, is suddenly released. The procedure makes it possible to perform a one-stage prostatectomy in from 75 to 80 per cent of cases of hypertrophied prostate. Adequate exposure of the interior of the bladder is obtained, a careful dissection of the hypertrophied lobes of the prostate can be made, and hemorrhage accurately controlled. In contrast to this operation is the blind two-stage operation, in which the prostate gland is dug out through a hole, about 1.5 cm in diameter, which pre-

viously held the cystostomy tube. This procedure is often accompanied or followed by serious hemorrhage which greatly reduces the patient's resistance.

End-Results That the foregoing procedures in the preparation of handicapped patients are of value is shown by comparing the end-results in these various conditions in the Clinic, before and after such methods were instituted. Wilder reports a mortality rate of less than 2 per cent in cases of diabetes in which operations were performed, as compared with 10 per cent four years ago, and 30 per cent as given by most of the standard text-books of surgery. Beikman reports that the mortality rate was reduced 50 per cent, in cases of gastric retention in which operation was performed during the last two years, and in which these pre-operative measures were employed. A similar reduction in the mortality rate in cases of exophthalmic goitre, in which operation was performed, is reported by Plummei, Boothby, and Pemberton. The mortality rate in cases of obstructive jaundice has decreased 50 per cent in the last two years, since these patients have been adequately prepared.

GAS GANGRENE

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IN 1882, Molier and Ponget first used the term "Gaseous gangrene" and from 1877 to 1881, Pasteur, Koch, Geffky and others isolated the bacillus which, because of its pathogenicity, was called the bacillus of malignant œdema. In 1892, Welch added the *B. perfringens* to this group. These have been increased until the group now consists of about 25 anaërobes and some 10 or 20 aerobes. The clinical classification of Weinberg and Seguin offers a convenient one for these lesions.

- (a) Virulent gas gangrene 1 Classical or emphysematous type
2 Toxic or œdematous type 3 Mixed form 4 Putrefactive type
(b) Avirulent gas gangrene

The Welch bacillus is the greatest producer of gas, and pure infections of it are apt to be the classical or emphysematous type. *B. fallax* and *B. aerofœtidus* are next in importance in the production of gas. The *B. œdematiens* and *vibrio septique* produce less gas and more œdema and predominate in the œdematous lesions. The mixed forms can be caused by any combination of the above, while the putrefactive group may show any and all combinations including the ordinary pyogens.

Major Coupal of the Army Medical School has called attention to the fact that muscle is a favorite tissue for these lesions and blood clots, blood serum, lung and liver are next in importance. Muscle only offers good soil for these infections, if it is damaged or its circulation is altered. Structures containing little muscle like the hands, the feet, and the bones of the face are more rarely involved. Blood clots or serum in the pleura or peritoneum are common sites while the brain is fairly free from this infection. Muscle covered by dense fascia is a favorite location as the initial œdema and gas formation are transposed into tension by the restriction of these dense fascias and this further embarrasses the circulation and favors rapid spread of the process. The lower calf and the thigh are examples of this class while the buttock, and the sacral regions have the same factors plus the fecal contamination.

High explosive wounds are the most liable to these infections because of the contaminating element. Pieces of uniform or dirt, both, carrying the members of the anaerobes are often planted deeply in the tissues by the large fragments. These missiles usually produce more damage to the soft parts than do bullets. The infection begins to show clinical signs in from four to six hours after the injury. The high explosive wounds and the high velocity bullet wounds with much bone comminutions, mushroom effect or vascular lesions being favorite types. Histologically, the muscle fibre shows shrinkage, failure to take the usual stains and an œdema sometimes

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amounting to the diameter of the muscle fibre itself confined within its sarcolemma. Bacteria usually found in larger quantities than in the ordinary infections occur in the connective tissue lining the finer muscle fibres. They seem to spread along these structures and are said by some to have the power of migrating along the coats of blood-vessels, especially when the structures have been damaged by hydraulics. The usual findings at autopsy in the true emphysematous types is the classical one of Welch septicaemia. These usually show a body-wasted jaundice, presenting a large foul smelling wound usually of the dense muscle areas with large quantities of hæmolyzed blood in the large vessels, a gas invaded foam-like clot in the heart and with all vascular intimas stained a deep red and with the so-called foam liver. This structure is soft, bright red and usually ruptures in manipulating. On section it yields quantities of hæmolyzed blood and fine bubbles.

Keith Inglis remarks that in war practice the mode of infection is similar in most instances. All cultivated soils are rich in anaerobic organisms originally derived from animal faeces, and shell wounds are frequently contaminated by such soil, the saccharolytic organisms most commonly found in infected wounds are bacillus Welchii, vibrio septique and bacillus oedematiens. They are responsible for the production of the spreading lesions of gas gangrene. Gas gangrene occurring in civil life may be divided into two classes according to the mode of infection. Class 1, includes those lesions in which like the gas gangrene of military practice, infection is due to contamination of the wounds by soil or material containing pathogenic anaerobes which originally came from animal feces. This class of lesions is not very uncommon and in the large metropolitan hospitals, wounds infected with gas producing bacteria are occasionally met with. Class 2, includes those lesions in which infection is not indirect by contaminated soil, but direct by the patient's own intestinal organisms. The type of lesion is uterine sepsis after abortion. Particularly criminal abortion. Inglis reports four cases of uterine sepsis ending fatally. In three instances gas bubbles were found in the liver and spleen, and the patient was probably infected by pathogenic anaerobes possibly from the patient's own alimentary tract. The endocardial valves, aortic intima, etc., were often dark red or even black in color. The intense generalized pigmentation seen in these three women was not observed by me in the soldiers who died from gas gangrene during the war.

Christopher says the early diagnosis is of the greatest moment. History of a recent wound, swelling, increased frequency of pulse rate, tympany, crepitus (auscultatory and palpatory), pale color of the skin, odor, ability to "milk" gas bubbles out of the wound, thin discharge, roentgenographic findings, and the maintained intelligence of the patient. In regard to treatment the preventive is naturally the most important. This consists of thorough early débridement of the wound, followed by dressing with Dakin's solution by the Carrel method, and delayed closure. It seems very desirable that serotherapy be more used in the preventive treatment. Once

gas gangrene has developed in a wound the first choice of attack is surgical. Radical removal of the gangrenous parts, multiple free incisions, and the Carrel-Dakin treatment should be employed. Christopher had a case of a structural iron worker whose left hand had sustained a severe crushing injury.

On admission 1500 units of tetanus antitoxin was given, and the Carrel-Dakin treatment of the wound was instituted. A week later a culture of the wound was reported as having gas bacilli as the predominating organism. Several phalanges were amputated and the raw area was skin-grafted by the Thiersch method from his thigh. The Carrel-Dakin was carried out daily. Eight months later the patient could write and row a boat.

Eugen Frankel and F. Wohlwill confirmed from guinea pig experiments and autopsies on four cases that there is no foundation for the theory that the fatal termination of the gas gangrene infection is not caused by toxic effects on the central nervous system.

Barney and Heller found that *B. Welchii* and *B. Chauvoei* are notable muscle feeders. The *vibrio septique* group may feed on muscle, but they show a preference for connective tissue, and for serous linings, and they also show a remarkable facility for spreading along the lymph and blood channels. Their invasions are, therefore, not to be controlled by incision of individual muscles as are Welch infections. Many of the organisms of the *oedematiens* group fail to spread rapidly from the site of inoculation, and act by means of toxins that advance far before them.

Muller reported a case in which an operation started up an old gas bacillus (*Welch-Nuttall*) infection, which had remained latent for one and a half years after a shell wound. After amputation of the leg the stump healed up, and an artificial leg was successfully adjusted. He thinks that a new infection was excised.

Van Gehuchten found in a large number of experiments with the ductless glands in guinea pigs, after infection with the gas bacilli that the alterations of the ductless glands are like those observed in other infections. The alterations are not marked in the thyroid and the pituitary, but are very deep in the suprarenal bodies. In the last named the hemorrhage lesions have always shown an extreme gravity. In the majority of cases in the animals who survived, there was a cortical insufficiency from lack of cholesterol, and a medullary insufficiency from deficient adrenalin secretion.

De Laverigne injected an emulsion of one of four gas bacilli into a guinea pig. One of these will be protected, and the same serum which has protected the guinea pig will protect the pig. In four per cent of cases, all the animals succumb, not only the animals protected by a single serum, but even the animal protected by the simultaneous injection of the three serums. The gas gangrene is the work either of a typical *v. septique* or of *b. sporogens*, or some other aberrant germ.

Haberland reports that the blood-vessels in gas gangrene are injured as follows. As the bacillus invades the vessel wall, the endothelium is in-

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jured, and the ground for a vital thrombosis formation is prepared. A serous hemorrhage suffusion of the subcutaneous and interstitial connective tissue will follow. The effect on the blood-vessels is thus a mechanical one although the toxin action is the definite one.

Sacquépée reported in 1920 at length on his experiments with gas gangrene. In a series of 191 cases of gangrene which he treated with Leclainche and Vallee's polyvalent serum or according to the De Lavergne method there were 166 cures and 25 deaths. The mortality in non-treated cases was 75 per cent. It can therefore be seen how far the curative treatment has been successful. It often operates in a striking manner, for in an entire series of cases in which any surgical interference was deemed inadvisable, the shock of the operation seemed bound to cause death and energetic serum treatment brought about such an improvement that the operation could be carried out subsequently at leisure with a minimum amount of danger.

Sacquépée emphasizes the value of preventive sero-therapy in cases of very severely wounded patients particularly exposed to gangrene (arterial wounds, laceration of the buttock, thigh, etc.,)

Amongst 319 cases treated preventively only 4 cases or 1.17 per cent of gangrene was observed. A series not treated by serum gave 7.2 per cent gangrene. The value of preventive sero-therapy is evident since it reduces cases of gas gangrene to a very slight number of those wounds which are most exposed.

It appears from information at hand that gas infection of the virulent type does appear now and then in the surgical service of most hospitals. When it is present in the extremities, its progress is so rapid that it rarely is diagnosed early enough for hopeful eradication by surgical means alone. The value of an early exhibition of properly prepared serum as a life-saving measure is indisputable, and its efficacy as a preventive measure by inhibiting the growth of the virulent forms of gas bacillus deserves recognition by the municipal departments of health.

Death from tetanus would seem unpardonable on account of neglect of a prophylactic dose of serum administered in a case of street injury. Nevertheless, it appears that one of the most potent therapeutic measures discovered as a result of the recent world war is either forgotten or we have not had an epidemic of this gas infection brought home to us, to the realization that prophylactic measures might be applied to prevent the occurrence of such disaster.

Of the few cases reported in the literature that recovered without serum therapy, all had come to a high amputation. The recovery of my case was undoubtedly due to the efficacy of the serum. A careful inquiry as to the possible source of supply of serum for treatment of gas bacillus infection, reveals that there is but one private laboratory that maintains any supply at all while the laboratories of the department of health and those of the army and navy have closed their eyes completely to the necessity of maintaining a supply of this prophylactic and life-saving remedy.

CASE REPORT—On Sunday, November 19th, a little girl aged nine was run over by a motorcycle and admitted to the Beth Israel Hospital with a deep, penetrating wound at the junction of the middle and lower third of the anterior aspect of the thigh. I saw her shortly after her admission and she presented considerable swelling due to hæmatoma. The wound was treated with iodine both this and the day following admission to the hospital. The report of the X-rays was negative.

The day following, which was Tuesday, the child presented an appearance of being very ill and her temperature had risen to 105° . An inspection of the thigh revealed everted edges of the wound, with no discharge. There was some discoloration of the skin. The child was immediately taken to the operating room. Upon incising the thigh, under anæsthesia, I found the extensor cruris muscle pulpy, of a terra cotta color and of gelatinous consistency. This destroyed and infected portion of muscle was excised. At least half of this muscle was involved. Underneath the extensor cruris was found a smudge which was made up of clot and hair, surrounded by liquefied muscle tissue. This was removed, and the contiguous and involved portion of the subcruris excised. The whole wound was iodized and the house surgeon instructed to prepare a Carrel-Dakin dressing with tubes for a flushing of the wound with the solution, every two hours.

The tissue excised was at once taken to the laboratory for immediate microscopic examination for possible gas bacillus. The report was submitted to me in about twenty minutes that the muscle tissue removed was infected with gas gangrene bacillus.

In the evening the child appeared to be extremely ill and stuporous. The thigh had become very much swollen and there were new areas of discoloration in the upper part of the thigh. The picture presented was that of the type of case for which, during the war, orders had emanated from the surgeon general's office that gas gangrene evident to a great extent in the regions of the thigh should be treated by immediate amputation followed by the Carrel-Dakin dressing.

The gas bacillus is recognized as one of the most fatal forms of infection, and was responsible for the loss of many thousands of soldiers during the first two years of the war on account of temporizing and conservative measures then practiced. Amputation saved many lives in the war as the usual antiseptics applied to infections have little or no influence upon tissues contaminated with it. In 1917 I had an opportunity of witnessing the very interesting experiments made by Doctor Bull of the War Demonstration of the Rockefeller Institute. The doctor, who had been working very zealously, thought that he had perfected a serum which would combat the ravages created by the gas bacillus infection. One of the experiments I recall was made as follows. Healthy pigeons were inoculated with a small quantity of gas bacilli. These invariably died within a half hour. When the bird was placed in an incubator its body would in less than an hour swell up to at least twice its natural size, and an incision of the muscles would be followed by an escape of gas which could be illuminated with a match. Other pigeons from the same group, injected with a similar quantity of gas bacilli, and at the same moment injected with a dose of Doctor Bull's serum, remained alive and well. This serum was taken abroad and proved utterly worthless for the infection of gas bacilli because it was found later that there were other types of gas bacilli unknown to Doctor Bull in which his serum did not seem to have any influence whatsoever.

The girl whose case I am now reporting, was given 105 c.c. of the serum obtained from the Lederle Laboratory. The serum was a mixture of Welch perfringens form of the gas bacillus type with tetanus. The patient developed a chill, and the administration was discontinued at that point. No amputation was done owing to the opposition of the family.

During the next two consecutive days the child received two more doses of the serum of 100 c.c. each and then began to show continued improvement. At the end of three weeks the wound was practically bacterially free, and I performed a secondary

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suture with an almost perfect primary union. Since then the child has been walking around and has recovered an almost perfect restoration of the function of the muscle by hypertrophy.

Upon inquiry I learned that at one of the hospitals, which has a very large ambulance service, that there were no less than three cases of gas gangrene treated in the course of a year, two which terminated fatally and the third recovered after an amputation of the upper extremity.

In the Journal of Railway Surgeons there are two cases of gas bacillus infection reported which occurred in the practice of Doctor Edmondson. One of these was the case of a boy who had fractured his leg which showed within forty-eight hours evidences of gas gangrene. A high amputation saved the boy's life. The other was a man of fifty years of age who had pricked his finger and gas gangrene set in. An amputation at the shoulder and repeated blood transfusion saved the man's life. Neither one of these cases was treated with serum.

Another case was reported during this last year in the Archives of Surgery by Barney and Heller, of San Francisco. This case resulted in a high amputation of the arm. Attention is called to this case of unusual form of infection in order to show that while it is a rare form, it does appear now and then in the course of our experience, and it must be treated radically, without delay. Any attempt to temporize is likely to be followed by a fatal outcome.

The bacteriological report on the slides of the tissues removed from the patient made by Dr. Morton C. Kahn. Morphologically, the bacteria in the specimen are very characteristic of the Welch type of gas gangrene bacillus. They are short plump bacilli with square end, and a diligent search reveals no spore bearing form (Fig. 1). The organism *Clostridium oedematiens* also gives similar characteristics. The morphology being, however, a more slender organism, and having tendency to sporulate. The Welch does not spore in the presence of carbohydrate, such as is present in the muscle.

He further states that the morphology of the bacteria presented have all the characteristics of the Welch type. Doctor Williams, assistant to Doctor Park (Board of Health Laboratories), reported as follows: The specimen of bacteria presented presents all the characteristics of an anaerobic form of bacillus. The appearance of the bacteria is characteristic of the virulent anaerobic gas bacillus, several groups of which have been isolated. While it cannot be stated with absolute certainty to what particular group these bacteria belong, without reproduction by culture, the appearance of the slide is nevertheless quite characteristic, and really could not be mistaken for anything else than one of the gas gangrene producing bacilli.

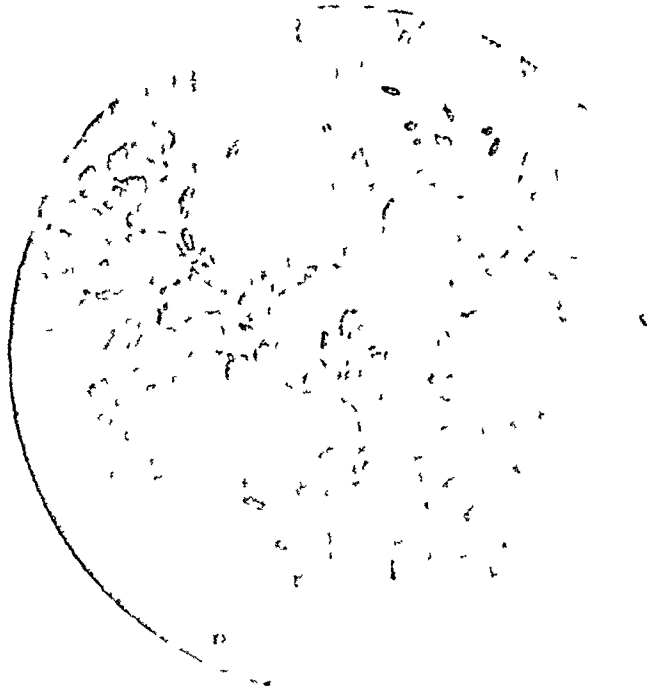


FIG. 1.—Microscopic section of tissues removed from patient. Bacteriological report by Morton C. Kahn. Morphologically, the bacteria in the specimen are very characteristic of the Welch type of gas gangrene bacillus. They are short plump bacilli with square end, and a diligent search reveals no spore bearing form.

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REFERENCES

- Coupal, Major Army Medical School, Washington, D C An unpublished lecture
Inglis, K M J Australia, vol 1, pp 7-9, Jan 6, 1923
Kahn, Morton C J Med Research, vol xliii, p 155, April-May, 1922
Edmonson Journal Railway Surgeons, 1922
Christopher, F Internat Clinics, vol 1, pp 129-135, 1922
Frankel, E, and Wohlwill, F Deutsche med Wchnschr, vol xlviii, pp 63-64, Jan 12, 1922
Barney, E L, and Heller, H H Arch Surg, vol iv, pp 470-484, 1922
Muller, H Beitr z klin Chir, vol cxxii, p 698, 1921
Van Gehuchten, P Ann de l'Inst Pasteur, vol xxxv, p 396, June, 1921
De Lavergne Lancet, vol ii, p 605, Sept 18, 1920
Saquepec, E Lancet, vol ii, p 605, Sept 18, 1920
Haberland, H F O Deutsche med Wchnschr, vol xlv p 491, May 1, 1919

THE INCIDENCE OF POST-OPERATIVE CATHETERIZATION IN THE JOHNS HOPKINS HOSPITAL^{*}

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THE attitude of the profession toward catheterization after operation has undergone considerable change during the last decade. Formerly the indications for the use of the catheter were ill-defined, some employing it freely whenever there appeared to be any complaint of distention in the lower abdomen from any cause, others, fearful of producing a cystitis, seeking to avoid its use except in cases of obvious overfilling. Methods were devised which sought to render the procedure free from danger by strict attention to asepsis and thorough cleansing of the meatus. Occasionally irrigations of the bladder or instillations were employed, but without any clearly defined indications or scientific basis for their use. The importance of residual urine as a predisposing factor in post-operative cystitis was occasionally mentioned. Its presence before operation was rarely looked for and post-operative retention was expected in a considerable number of cases. These were catheterized as a routine measure at regular or irregular intervals until the patient was able to void without assistance. If no obvious cystitis developed, no further attention was paid to the bladder or the possible presence of residual urine. Here and there a voice was raised in protest, notably Taussig, Kolischer and Curtis, but apparently little attention was paid to their suggestions.

Surgical progress was, however, being made along certain relevant lines, such as increase in the rapidity of operating, the elimination of trauma to tissues left behind, the use of better anæsthesia and the reduction of pain and discomfort after operation. A careful, detailed comparison of the various methods employed would doubtless reveal many instances of altered technic in operation or dressing that influence the urinary mechanism.

A comparison was made between an American series¹ and one collected in Korea² in order to determine the influence of race and necessary methods of hospitalization upon the urinary function as affected by operation. However, the interval between observations was so long (9 years) that the effect of improved technic could not be safely disregarded. In view of contemplated studies upon another Oriental race, the Chinese, it was felt that such a series as that embodied in this paper would bring to light the results of any such alteration in operative procedure and improvement in the attitude toward catheterization.

Personal observation of any of these cases has not been possible, the data being entirely obtained from the hospital records, to which access was secured through the permission of Dr. Ralph B. Seem, Assistant Superintendent, and

^{*} From the Department of Pathology, Peking Union Medical College

the cordial cooperation of Miss Frances Riach, Custodian of Records Drs J P Maxwell and A S Taylor, at that time connected with the Departments of Gynecology and Surgery respectively, have kindly furnished much collateral data in regard to the various regulations and procedures Miss Anna D Wolf, formerly of the nursing staff, has also added valuable information My special thanks are extended to Drs T S Cullen, Guy L Hunner, D B Casler, E H Richardson, and L R Wharton for their sympathetic interest in this investigation and their many helpful suggestions

The cases summarized are from the surgical, gynecological and urological services of the Johns Hopkin's Hospital and include practically all those operated between June 1, 1918, and February 15, 1920 Only those are here considered which conform to the postulates laid down in the first article In brief they are as follows

- 1 The operation must have involved the cutting of tissue
- 2 It must have been performed under general oral anæsthesia
- 3 The patient must not have been comatose before or abnormally long after operation
- 4 Patients must have been twelve or more years of age
- 5 They must have had apparently normal control of the urinary function
- 6 They must have lived at least twelve hours after operation
- 7 Obstetric operations of all kinds are excluded
- 8 All cases have been disregarded where drainage with a retention catheter was maintained or where catheterization was done at short intervals for reasons connected with the particular operation

The operations conforming to these limitations are divided into the following 14 groups

- 1 Operations on the rectum and anus
- 2 Operations on the penis and scrotum, including the male perineum
- 3 Operations on the vagina, including female perineum, but excepting dilatation of the cervix and curettage
- 4 Abdominal operations involving the female pelvic organs
- 5 Dilatation and curettage of the uterus
- 6 Operations for hernia, inguinal and femoral, both sexes
- 7 Operations on the kidney and ureter
- 8 Operations in the abdomen not gynecological, including abscess and operations on the liver
- 9 Operations on the chest, abdominal wall, back and hips
- 10 Operations on the arm
- 11 Operations on the leg, including inguinal suppuration
- 12 Operations on the head and neck, except Nos 13 and 14
- 13 Operations on the mastoid
- 14 Operative removal of tonsils and adenoids

The routine for the care of gynecological patients, so far as it concerns this study, contains the following orders to nurses and house officers

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I Admission of Patients Water forced Specimen of urine to the laboratory If patient does not void for 12 hours, notify doctor

II Preparation for Operation Nothing by mouth after midnight except water Voided specimen to laboratory, morning of operation Catheterization of all patients under anaesthesia before operation †

III Post-operative Care - Water forced All patients may be turned in bed unless otherwise ordered No patient may sit up, get into a chair, or walk without orders Specimen of urine to laboratory morning after operation and q 7 days Catheterization orders for all patients except D and C

1 If patient is uncomfortable, she may be catheterized at any time after 8 hours following return to the ward If the patient is comfortable, she need not be catheterized until 12 hours after her return

2 After the first catheterization, she shall be catheterized q 12 hours until she voids 100 c c, or more at one time

3 After D and C no patient is to be catheterized except by special order

4 Patient may be raised in Gatch bed, if necessary, to assist her to void ‡

5 When any patient who is not being catheterized has not voided for 12 hours, notify doctor

Bladder instillation, silver nitrate, 1-2000, oz 1, is to be given daily if patient has to be catheterized over 36 hours This treatment is to be continued as long as the patient has to be catheterized

The routine on the surgical service was not so explicit in regard to catheterization, each case being subject to individual orders When a patient did not void, the interne was notified and efforts were made to bring about urination If the bladder was not distended and the patient was comfortable, he was allowed to wait Fluids were forced if possible, warm enemas used and the patients allowed to rise up or stand when advisable from the operative point of view No definite time limit was set within which every patient must urinate or be catheterized

The use of drugs before and after operation has apparently been quite free A preliminary injection of morphine 1/6 gr and atropine 1/100 gr was the rule, except with children, and was often repeated within the first 6 hours or sooner, in case of great pain it was given again Complaints of pain from gas were often noted on the charts and in such cases eserine 1/100 gr and strychnine 1/40 gr were commonly employed No instance where benzyl benzoate was used to overcome the spasticity induced by morphine was observed Pituitrin was also occasionally administered

I OPERATIONS ON THE RECTUM AND ANUS

All of the catheterized patients were women, of whom six had a suture of the rectal sphincter as part of a perineal repair All except one had some form of associated vaginal operation Fourteen hours was the longest time that elapsed before the catheter

† Personal communication from Dr Guy L. Hunner

‡ Personal communication from Dr D. B. Casler

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was used In this case the patient had voided 30 c c before catheterization, the catheterized specimen measuring 250 c c Another patient with suture of the sphincter and perineal repair was catheterized after seven hours by special order The amount obtained was 250 c c , "slight discomfort" was noted on the chart The patient from whom a rectal polyp was removed was "waked for treatment" (*i e*, catheterization) at the expiration of twelve hours, in spite of the fact that she had voided 50 c c one and one-half hours before Much nausea and vomiting was noted in one history and "very nervous" in another One woman seventy-one years of age was catheterized a great many times after an operation for hemorrhoids and anterior and posterior colporrhaphy She was "uncomfortable from bladder distention" and by catheter 275 c c were withdrawn Approximately every eight hours thereafter the catheter was used, yielding the following amounts 200, 500, 450, 150, 350, 425, 400, 400, 150, 225, 200, 100, 500, 325, 850, 800,

TABLE I

Operation	Catheterized	Voided
Fistula		11
Hemorrhoids	2	31
Hemorrhoids and fistula		1
Abscess		8
Mucous polyp	1	
Atresia ani		1
Suture of sphincter	6	2
Carcinoma (Kraske)		2
Ulcer excision		4
Fissure		1
Totals	9	61

250 and 925 c c After the fifth catheterization the note is made, "no complaint" The charting was discontinued while the patient was still being catheterized There were no urinary records on the charts to indicate the condition of the urine, but there was evidently no serious difficulty or the records would have had some special entry There was apparently an atonic condition of the bladder and the irregularity of the size of the specimens obtained suggests a variation in the technic used and the presence of considerable residual urine The amounts stood in no relation to the diet, time of day, or any discoverable factor Two of the women were colored and seven were white

Of the non-catheterized patients 37 were men and 24 women, 42 were white and 19 colored As compared with the St Luke's series, there was a notable decrease in the frequency of catheterization in three groups, namely, fistula, hemorrhoids and perirectal abscess Formerly these were dressed with large gauze packs or rolls of gauze of which the patients frequently complained bitterly Several stated that the presence of the dressings prevented them from urinating, the truth of their statement being evident when they voided without difficulty after its removal The two patients subjected to the Kraske operation for cancer of the rectum voided without difficulty after eleven and eighteen hours, respectively On only four of the patients who voided was any gynæcological operation done

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2 OPERATIONS ON THE PENIS AND SCROTUM, INCLUDING THE MALE PERINEUM

One patient operated for double hydrocele was catheterized after twenty hours, withdrawing 75 c c. Note on the chart stated that the man was "quiet and comfortable". The St. Luke's figures were 4 catheterized and 18 voided. The tendency of surgeons

TABLE II

Operation	Catheterized	Voided
Varicocele		16
Varicocele and hydrocele		2
Circumcision		2
Epididymectomy		17
Castration		9
Periurethral abscess		2
Hydrocele	1	21
Perineal fistula		5
Vesiculectomy		6
Miscellaneous		9
Totals	1	89

to delay the use of the catheter is here shown very clearly. Thirty-five patients urinated voluntarily within eight hours after operation and 52 delayed longer. It is impossible to say how many of the latter group would have been able to void within eight hours if they had been urged to do so.

3 OPERATIONS ON THE VAGINA, INCLUDING FEMALE PERINLUM

Several operations were more complicated than would appear from the table above. There were 3 vaginal suspensions of the uterus, 2 of the patients voided. The urethral orifice was repaired in 3 individuals, 2 of them being catheterized, the charts leaving an

TABLE III

Operation	Catheterized	Voided
Plastic repair in vagina	4	20
Perineal repair	18	18
Pelvic puncture	6	27
Miscellaneous	2	6
Totals	30	71

uncertainty as to whether or not this was done by special order. In grouping the cases the most important or extensive operation was selected, having in mind the possible influence of the procedure upon the nerve or blood supply of the urethra and neck of the bladder. Fifteen patients on whom colporrhaphy was performed were cathe-

terized and 5 voided, of those in whom vaginal fixation was done, 2 urinated and 2 were catheterized

4 ABDOMINAL OPERATIONS ON THE FEMALE PELVIC ORGANS

A classification of operations involving the wide variety of combinations would have been very cumbersome. Simple hysterectomy was usually done for uterine tumors of benign nature, whereas pan-hysterectomy with removal of the adnexa covered the malignant tumors and extensive pelvic changes

TABLE IV

Operation	Catheterized	Voided
Uterine suspension	43	38
Hysterectomy, simple	16	20
Hysterectomy and removal tubes and ovaries	57	56
Removal tubes or ovaries (uni- or bilateral)	29	62
Totals	145	176

following prolonged infection. Cases involving the removal of tubes and ovaries on one or both sides for all causes were grouped together. Suspension of the uterus, whether alone or combined with other operations, was considered as a single group because of the mechanical effect upon the bladder. All four groups of operations were believed to influence more or less the nerve and blood supply to the bladder and hence to be directly related to the patient's control of micturition.

Subject to the rules in force governing the post-operative catheterization of gynecological patients, it appears that a little more than half of the women voided without instrumental assistance. This ratio, however, is not maintained in all the groups. The effect of pressure of the uterus against the bladder is seen in the fact that forty-three were catheterized and only thirty-eight voided. A further analysis of the cases shows

Operations	Catheterized	Voided
Uterine suspension alone	—	9
Combined with adhesions	4	3
Combined with appendicitis	2	5
Combined with other pelvic operations	37	21
Totals	43	38

Apparently, then, uterine fixation alone did not interfere with urination, but when combined with other operations, particularly those on the pelvic organs, a distinct influence was noted.

Removal of the supravaginal portion of the uterus, as for uncomplicated fibromyomata, had little effect upon bladder function. Only two such simple operations are included in the catheterized group, and twelve of the other

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fourteen were combined with appendectomy. In the non-catheterized group there were four simple hysterectomies and sixteen combined with appendectomy. The number of appendices removed would indicate that this was almost a routine measure. Comparison of these two small groups indicates also that when the abdomen is once opened for any operative procedure the additional trauma incident to an appendectomy has little or no influence upon the urinary mechanism. Such interference as is noted in simple appendectomy must be attributed largely to the laparotomy and the technic that goes with it.

Complete removal of the uterus and more or less of the adjacent organs is a more formidable operation, the number of catheterized patients being equal to the non-catheterized. The influence of the additional removal of portions of the adnexa is suggested by the fact that when these alone were removed, more than twice as many patients voided as were catheterized. Proper deductions must be made in this group for the influence of the laparotomy, as was noted in the case of appendectomy.

5. DILATATION AND CURETTAGE OF THE UTERUS

This operation alone was employed in the treatment of seventy women of whom three were catheterized. Patients after this operation were allowed to go longer than in the two preceding groups of cases, the periods being 16, 25 and 12 hours. The amounts recovered were 875, 400 and 300 respectively. They were all young married women, aged twenty-six, two colored and one white, and were very uncomfortable after operation. The white woman whose bladder contained 400 c c was the only one who complained of "fullness in the bladder region." The catheter was used only once in each case. The voiding interval in the non-catheterized cases averaged a little over 8 hours, the extremes being 1 and 17 hours.

6. OPERATIONS FOR HERNIA, INGUINAL AND FEMORAL, BOTH SEXES

In the group of catheterized patients there were 2 women and 5 men, one of the women being colored. Of those that voided 16 were women and 159 men. Forty-one of the individuals were colored and 134 white; the

TABLE V

Operation	Catheterized	Voided
Inguinal, direct	3	10
Inguinal, indirect	3	138
Inguinal, double	1	21
Femoral	0	6
Totals ..	7	175

number of colored women with inguinal hernia seemed disproportionately large. In 2 of the catheterized patients it seems all together likely that pre-operation urination was forgotten, as 950 and 500 c.c. were withdrawn after

2 and 6 hours respectively Six hundred c c were obtained from a third patient after $7\frac{1}{2}$ hours Five of the patients were catheterized only once and in all of them pain and discomfort were specially recorded One was catheterized twice and one five times The amounts in all instances were up to or above the average

The time interval for the voided cases was extremely variable, but the average was high The maximum amount for the whole series is found in this group, 1750 c c, voided after an interval of 28 hours There was no evidence that the patient was injured by the unusual distention or that urination was affected during the remainder of his stay in the hospital

7 OPERATIONS ON THE KIDNEY AND URETER

Eighty-eight reports are here considered, 11 patients were catheterized from 1 to 3 times The amounts recovered by catheter and after voiding show the greatest variation, from 10 c c after a 12-hour interval to 925 c c after 10

TABLE VI

Operation	Catheterized	Voided
Nephrectomy	8	56
Nephrotomy—unilateral	2	7
Nephrotomy—bilateral	1	
Ureterotomy		5
Pyelotomy		9
Totals	11	77

hours In the latter case it is highly probable that the patient did not urinate immediately before operation Morphine had been freely used before and after operation and this seemed to be an important factor in disturbing the urinary mechanism, especially in the catheterized cases "Distention" and "discomfort from inability to void" were more frequently noted on the charts than in any of the preceding groups of cases

The possible effect of the kidney operation upon the urinary output was of supreme importance in many of these cases and doubtless led to the use of the catheter after such short intervals as 3 to 5 hours for the sole purpose of diagnosis A tabulation of the nephrectomy cases according to the urination interval and output gives a surprising lack of uniformity in results One patient after 2 hours passed 150 c c and another voided 300 c c after 17 hours Six of the recorded amounts were below 100 c c and represented either incomplete samples or an abnormally low rate of excretion Nephrotomy, pyelotomy and ureterotomy had a more noticeable effect upon the initial urinary output than nephrectomy

INCIDENCE OF POST-OPERATIVE CATHETERIZATION

8. OPERATIONS ON THE ABDOMEN NOT GYNÆCOLOGICAL

The most noticeable advance in surgical procedure indicated by the operations listed is the frequency with which the more serious operations, such as splenectomy and resection of the stomach, were undertaken. Excision of

TABLE VII

Operation	Catheterized	Voided
Exploratory laparotomy.	3	28
Fecal fistula	1	4
Appendectomy	27	155
Gastro-enterostomy	2	18
Gastrotomy	0	11
Gastrectomy for cancer	0	7
Cholecystotomy	0	9
Cholecystectomy	8	42
Cholecyst-enterostomy	0	1
Choledochotomy	2	4
Cholostomy	0	7
Enterotomy	0	1
Entero-enterostomy with resection	1	12
Intestinal obstruction	3	3
Peritonitis with drainage	0	18
Adhesions	4	15
Liver abscess	0	12
Retroperitoneal cyst	0	2
Splenectomy	1	3
Ventral hernia	3	12
Miscellaneous	0	1
Totals	55	365

the gall-bladder has largely replaced cholecystotomy and appendectomy has become still more frequent. Liver abscess is more often diagnosed and treated by operation than in former years, possibly indicating an increase in amoebic infection, an intestinal condition occasionally found in the vicinity of Baltimore.

In general the operations in the upper abdomen were not so likely to influence the function of the bladder as those on the organs lower down. Most patients were catheterized after 10 hours, the periods ranging from 11

to 20 hours or longer Twenty-two patients were catheterized 2 or more times and of this number all but 2 were women Five of the catheterized patients were colored, all of them being women Seven was the greatest number of times any person was catheterized, this patient being a psychopath who had a checkered post-operative record and who was transferred to the psychiatric service upon recovery from this operation None of the operations involved the bladder in any way

In this group 45 per cent of the patients were women, a proportion somewhat smaller than it would have been if all who had any operation on the pelvic organs had not been so rigidly placed in group 4 As it stands, however, four times as many women were catheterized as men A list of the operations done on the male patients catheterized shows them to be of a more severe grade They are appendectomy, 7 cases, gall-bladder, 3, and splenectomy, fecal fistula, resection and intestinal obstruction, 1 each The frequency of bladder difficulty, even in the operations of lesser degree, suggests strongly either the prominence of the nervous element or the existence of a previous pathological condition of the bladder, or both

9 OPERATIONS ON THE CHEST, ABDOMINAL WALL, BACK AND HIPS

Seven of these patients were catheterized and 123 voided without assistance Five of the former were women and all were white The amount of urine withdrawn was over 500 c c in all except one case where after 22 hours

TABLE VIII

Operation	Catheterized	Voided
Amputation of the breast	2	45
Abscess and sinuses		12
Osteomyelitis		8
Thoracotomy		34
Tumors	1	9
Bone graft (Albee)	3	6
Plastic operations		2
Laminectomy		7
Incision and cautery	1	
Totals	7	123

250 c c were obtained Confinement in a plaster bandage and much pain were noted as contributing factors, but there were no symptoms referable to bladder distention. One woman whose breast was incised and cauterized was catheterized after 23 hours and 700 c c of urine withdrawn One man from whose chest wall a tumor had been removed passed small quantities, as 50 c c, 40 c c, 75 c c, etc., at intervals for 25 hours and was finally catheterized with the recovery of 750 c c He was in extreme pain but not because of a full bladder

INCIDENCE OF POST-OPERATIVE CATHETERIZATION

A woman of fifty-two with complete breast amputation was catheterized 10 times, the first time after 20 hours with removal of 750 c c Urotropin treatment was begun the second day and the cystitis was said to have cleared up before discharge. The cases of Albee bone graft to the spine were more seriously inconvenienced than the other operative cases, the supine position and pain, chiefly in the leg, were especially commented upon. These 3 were all young women in some of whom nervous symptoms were quite pronounced. There is no evidence that any local changes in the cord in the region of the graft affected the bladder control. No other pressure symptoms were noted in the history of these patients. Operations of lesser severity allowing the patients more freedom of motion in bed were not attended with any functional disturbances of the bladder.

IO OPERATIONS ON THE ARM

In all, 67 patients were treated, all of whom voided. The series contained the usual proportion of amputations and incisions for infection, osteomyelitis, tumors and plastic operations.

II OPERATIONS ON THE LEG

Two hundred patients were operated for conditions affecting the leg, of whom 3 were catheterized. One young soldier whose leg had been amputated was catheterized once after an interval of 21 hours, at which time 625 c.c. were removed. He had great pain from twitching of the muscles and was given morphine freely for its control. Bladder distention was distressing. This man was again operated 10 days later for infection of the amputation stump and 400 c c of urine were removed by catheter after 7 hours. The other case, also a young man of the same age, had an open reduction of a fracture of the femur with insertion of a bone splint. He, too, was in great pain; nausea and vomiting persisted and some shock was present. Morphine was given freely. Six hundred c c were removed by catheter after an 11 hour interval.

12 OPERATIONS ON THE HEAD AND NECK

This group includes 475 operations of very diversified nature. Operations on the thyroid were performed on 161 patients and brain surgery was conspicuous on the list. Seven patients were catheterized, of whom four were operated for thyroid conditions. The numerous entries on the charts indicate the extreme nervous condition of these patients. "Worried over self," "nervous and worried," "noise in the head," "twitching of body," "teeth chattering," were notations usually indicating hyperthyroidism. One young woman of eighteen on whom a plastic operation on the nose was performed was relieved by catheter of 800 c.c. after an interval of 22 hours. The charts spoke of her as "kicking and crying" and "very unreasonable." The other two operated patients, one for hypophyseal tumor and the other for decompression, were not characterized in any special way on the charts, but there is some lingering doubt as to whether or not they were in full possession of their mental faculties. Each was catheterized twice at intervals of from 14 to 26 hours with the recovery of from 300 to 600 c c of urine.

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13 OPERATIONS ON THE MASTOID

Thirty-nine operations are recorded with only one patient catheterized. In this case the reason for the urinary difficulty was not apparent. He was an unmarried farmer, fifty-three years of age, who was relieved of 775 c c after an interval of 24 hours. He was charted as being "very thirsty," although no water was given him until after midnight. There was no mention of nausea and vomiting although he was in considerable pain.

14 REMOVAL OF TONSILS AND ADENOIDS

In all there are 230 operations recorded. No patient was catheterized.

TABLE IX
COMPARISON OF CATHETERIZED DATA, ST LUKE'S AND JOHNS HOPKINS
ST LUKE'S JOHNS HOPKINS

Groups of Operative Cases	Catheterized	Voided	Catheterized	Voided
1 Operations on the rectum and anus	16 48 7%	17	9 12 9%	61
2 Operations on the penis and scrotum	4 18%	18	1 1 1%	90
3 Operations on the vagina, and adjacent perineum (excluding No. 5)	4 18%	18	30 29 7%	71
4 Abdominal operations on the female pelvic organs	8 22%	28	145 45 2%	176
5 Dilatation and curettage of the uterus	2 4%	48	3 4 3%	67
6 Operations for hernia, inguinal and femoral, both sexes	9 16 4%	46	7 3 8%	175
7 Operations on the kidney and ureter	3 50%	3	11 13 6%	77
8 Operations in the abdomen not gynaecological	23 17 5%	108	55 13 1%	365
9 Operations on chest, abdominal wall, back and hips	0 0%	16	7 5 4%	123
10 Operations on the arm	1 2 3%	43	0 0%	67
11 Operations on the leg and groin	0 0%	91	3 1 5%	197
12 Operations on the head and neck (excluding Nos. 13 and 14)	1 1 1%	92	7 1 5%	468
13 Operations on the mastoid	4 13 8%	25	1 2 6%	38
14 Operative removal of tonsils and adenoids				*
Totals	75 11 94%	553	279 12 38%	1975

* These figures are omitted for the more accurate comparison with the St. Luke's reports, for which this group are incomplete.

INCIDENCE OF POST-OPERATIVE CATHETERIZATION

A survey of this table indicates that, in spite of the advance in surgical technic, the percentage of patients catheterized remains about the same. There is considerable variation in the individual groups, but as a whole there is little change. There is a notable increase in the time allowed for urination by the surgical service, but any reduction in percentage resulting from this cause is more than offset by the increase in the gynecological service. One of the factors responsible for this, as mentioned previously, is the increased use of the catheter as a diagnostic instrument for the detection and control of residual urine. Strict adherence to a time limit within which every patient must urinate or be catheterized has been the largest factor in this increase.

TABLE X
INFLUENCE OF SEX UPON CATHETERIZATION

Group	Catheterized		Voided		% Catheterized	
	Male	Female	Male	Female	Male	Female
1	0	9	37	24	0	27%
2	1		90		1.1%	
3		30		71		29.7
4		145		176		45.2
5		3		67		4.3
6	5	2	159	16	3	11.1
7	7	4	62	15	10.1	22.2
8	13	42	213	152	5.8	21.6
9	1	6	55	68	1.9	8.1
10	0	0	43	24	0	0
11	2	1	135	62	1.4	1.4
12	1	6	238	230	4	2.5
13	1	0	20	18	5	0
14	0	0	92	138	0	0
Totals	31	248	1144	1061	2.64%	18.94%

The peculiar predisposition of women to post-operative bladder disturbance is clearly shown in the table above. The fact that many of the women were under a special routine for post-operative care complicates the picture somewhat when considering the whole series. For example, at least 7 out of the 9 rectal cases that were catheterized were under the gynecological routine and so far as their operation is concerned might as well have been included in group 3.

The high incidence of catheterization in the groups composed entirely of women is highly suggestive when compared with group 2 in which men only

are concerned Group 8 is perhaps as representative as any, in that all the patients were under the same service and presumably both sexes were treated alike The fact remains that from whatever aspect the subject is viewed, women are much more liable to urination difficulties than men

TABLE XI
INFLUENCE OF SOCIAL STATE UPON CATHETERIZATION—MALES

Age	Catheterized		Voided		% Catheterized	
	Single	Married	Single	Married	Single	Married
12-19	2	0	147	2	1 3%	0
20-29	7	4	218	112	3 1	3 5
30-39	1	2	85	160	1 1	1 2
40-49	0	9	38	191	0	4 5
50-59	1	3	15	116	6 6	2 5
60-69	0	2	5	45	0	4
70-79	0	0	1	3	0	0
80-	0	0	0	2	0	0
Totals	11	20	509	631	2 1%	3 1%

FEMALES

12-19	9	11	137	13	6 2%	45 8%
20-29	19	57	159	221	10 7	20 5
30-39	6	68	50	227	10 7	23 1
40-49	5	45	13	130	25	25 7
50-59	1	21	9	68	10	23 6
60-69	0	4	4	25	0	12 1
70-79	0	1	1	5	0	12 5
80-	0	0	0	0	0	0
Totals	40	207	373	689	9 7%	23 1%

The influence of marriage upon catheterization is apparently very slight in the case of men, but much more definite in women Undoubtedly the influence of age in this tabulation cannot be safely disregarded, but in the groups of earlier decades the contrast between the figures for married and single is quite definite

The influence of sexual activity upon the functional control of the bladder has been mentioned in a previous paper In that series the patients were for the most part under direct observation, hence an opinion in this matter could be expressed with more confidence Those listed as married are not all those

INCIDENCE OF POST-OPERATIVE CATHETERIZATION

in whom libido is a dominant passion, and conversely those who are single are not necessarily to be considered as devoid of it nor lacking in the opportunities to gratify it. However, it appears that a strong sexual instinct, a more or less unstable nervous temperament and bladder difficulties after operation are very commonly associated.

The marked frequency of catheterization in women during and after the child-bearing age is undoubtedly due to the alterations in organs incident to pregnancy and the frequent complications and sequellæ thereto.

THE INFLUENCE OF RACE UPON CATHETERIZATION

All patients were classified as to race into two groups, white and colored. The latter includes all negroes and those with any admixture of negro blood, the white race includes all others. There are relatively few Jews in the series as they are, for the most part, cared for in their own hospital nearby. Almost every other race is represented except those from the Orient.

Among the catheterized patients 210 were white and 68 colored, and among the patients that voided 1713 were white and 492 colored. The percentage of whites catheterized was 10.9 per cent and of the colored 12.1 per cent. In 7 out of 14 groups there were no catheterized colored patients, while the whites were represented in all groups except 2. Fifty-three out of the 68 catheterized negroes were found in group 4, the remaining 13 being scattered. The 68 reports of catheterization are all from women, not a single male negro being catheterized.

The relative immunity of negro men from disturbances of bladder function agrees closely with the deductions as to the important factors, particularly those referring to temperament. As a rule the colored race, at least those that ordinarily reach the hospital from the out-patient department, are phlegmatic, easy-going and without ambition or "nerves" in the usual sense of the word. Their sensibilities are low and to that extent they appear to endure ordinary pain in much the same way that Koreans do. However, their fortitude is somewhat lacking, for they easily become panicky and lose control of themselves. Particularly is this true of the women. The difficulties experienced by nurses in the control of these women after serious operation are sometimes very great.

On the basis of a much longer experience with these patients than is covered by this review, Casler feels that colored women do not have to be catheterized as frequently as white women. It has been his impression that there were few neurotic individuals in the colored wards and that any deductions drawn from these figures would, therefore, not be correct as regards colored women. He feels equally certain that the proportion of Jewish women that have to be catheterized is much higher than the Gentiles.¶

The capacity of the normal bladder has been studied by physiologists and surgeons with results somewhat at variance. Physiologists usually state that the detrusor muscles begin more decided contractions when the content of

¶ Personal communication from Dr. D. B. Casler.

the bladder reaches about 250 c c and the intravesical pressure is 150 mm of water

Hunner and Lyon³ tested the capacity of a small series of female patients using distention with air and with fluid. With air the capacity averaged about 300 c c, and with fluids a little more than 400 c c. Under anaesthesia the capacity was somewhat greater than when the patients were conscious. The bladder walls of nulliparous women were apparently more elastic and capable of painless distention than those of parous women, a condition thought to be due to sclerotic changes in the latter following or incident to pregnancy and labor.

Study of the graphs of the amounts of urine obtained by urination and catheterization shows that the greatest number of specimens obtained by either method lies between 300 and 349 c c. Of the voided specimens 1351, or 77.2 per cent, were below 400 c c in amount and of the catheterized specimens 372, or 57.2 per cent, did not exceed that figure. These are well within the generally accepted limits of distensibility and the presence of these amounts certainly had no deleterious effect upon the bladder walls. In chronically distended bladders the presence of a much greater amount would probably not add to the injury already done, and more urine would be needed to initiate the reflex mechanism.

Taussig⁴ has summarized the results of catheterization in a series of gynecological cases, excluding dilatation and curettage, and finds that 23.2 per cent were catheterized. Our series for the same group gives 41.5 per cent, although he does not state the exact conditions under which the catheter was used. He also tabulates 311 cases which voided. Evidently no definite time limit was set within which urination or catheterization must take place, as there is given a summary by hours within which urination took place. These include various periods, the highest being 20 hours or more. The greatest number of cases, 94, voided between 10 and 12 hours, the largest being 82, between 7 and 9 hours. These periods are distinctly longer for the maximum number and the nearest one to it, being for our series 6 and 8 hours respectively. In Taussig's series 180 c c was the amount voided by the greatest number of patients, and only 5.8 per cent exceeded 360 c c.

The following table gives the amounts of urine passed both by voiding and by catheter according to the interval that elapsed after operation.

It would be impossible to estimate exactly the hourly excretion of the kidneys in each case, owing to the varying amounts that the bladder contained at the completion of the operation. This could have been determined with exactness only by routine catheterization at this time and the recording of the exact time of emptying the bladder and the amount it contained. The value of these figures is, therefore, greatly decreased, but they are sufficiently accurate to enable us to make comparison between the voided and catheterized specimens and to cause us to realize clearly that recovery from the effects of operation varies within wide limits so far as kidney secretion is concerned. This emphasizes the desirability of treating each patient as an individual.

INCIDENCE OF POST-OPERATIVE CATHETERIZATION

TABLE XII

Catheterized Specimens					Voided Specimens					
Interval in Hours	No of Reports	Mini- mum in c c	Maxi- mum in c c	Aver- age in c c	St Luke's	No of Reports	Mini- mum in c c	Maxi- mum in c c	Aver- age in c c	St Luke's
1/2				—		1	200	200	200	
1	1	400	400	400		10	130	500	230	
1 1/2						5	50	500	300	
2	8	85	1000	470		33	10	500	223	120
2 1/2				—		6	25	375	241	
3	6	60	425	219		72	10	725	258	180
3 1/2						5	50	300	190	390
4	6	60	650	319		110	30	650	252	214
4 1/2						12	50	410	222	360
5	6	90	700	272		149	15	600	255	160
5 1/2						17	25	500	220	160
6	24	50	700	356		214	15	800	249	264
6 1/2						29	100	700	261	230
7	18	75	800	417		176	5	750	234	203
7 1/2		.			360	19	100	650	314	150
8	40	25	800	325		192	25	500	260	285
8 1/2					240	18	20	600	312	257
9	37	125	800	487	360	155	25	900	265	200
9 1/2					300	16	25	500	252	240
10	46	30	880	382	202	144	40	925	278	260
11	58	25	850	372	360	134	20	950	295	258
12	276	10	1150	399	442	126	25	750	311	212
13	35	200	700	375	480	59	25	800	301	240
14	21	225	1000	488	420	55	25	700	318	240
15	9	150	1175	548	390	53	10	650	268	
16	13	200	875	446	480	46	100	810	368	
17	9	300	1000	586	450	45	40	800	358	
18	2	500	850	675		43	15	750	323	240
19						28	30	500	369	
20	4	625	750	719		24	40	850	389	
21	5	150	700	435		23	20	1100	388	

RALPH G MILLS

TABLE XII—CONTINUED

Catheterized Specimens					Voided Specimens					
Interval in Hours	No of Reports	Minimum in c c	Maximum in c c	Average in c c	St Luke's	No of Reports	Minimum in c c	Maximum in c c	Average in c c	St Luke's
22	5	250	800	495		16	100	750	324	
23	4	100	700	487		18	75	1000	378	
24	4	25	1350	567		13	175	650	423	300
25	5	200	425	340		16	50	1675	369	
26	2	600	900	750		6	250	600	458	
27	1	325	325	325		3	150	500	263	
28	1	850	850	850		4	200	1750	645	
29						2	300	650	475	
30	1	650	650	650		2	330	630	490	
31	1	400	400	400						
32	1	750	750	750		1	525	525	525	
33						1	150	150	150	
Totals	649	10	1350	407 c c		2001	5	1750	286 c c	

rather than in the aggregate, as would be the case where specific rules are laid down for their catheterization

The general average for catheterized specimens is, as would be expected, materially higher than for voided specimens. That this is no accident is shown by the fact that hour by hour the figures are higher. As compared with the St Luke's figures, a surprising number of cases were catheterized after very short intervals following operation. In some instances the records show that these followed shortly after a urination at which only a small amount of urine was passed. These, doubtless, have been for diagnostic purposes to detect a possible residual urine that was not previously suspected. If so, this would seem to be a logical procedure. The column indicating the maximum amounts for each time interval is instructive as showing how early a large amount of urine may be present in the bladder. The routine for emptying the bladder before operation is not sufficiently specific except on the gynaecological service, so that even several hours might intervene between that act and the conclusion of the operation. Some of these instances where large amounts of urine were found in the bladder a short time after operation might have been produced in this way. This places the house officers at a distinct disadvantage when diagnosing the cause of pelvic pain and complaints of distention, especially when dealing with those patients whose charts were commenced at the time they were taken to the operating room. Many charts gave no record whatever of any pre-operative urination.

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The record of voided specimens is instructive in indicating a combination of the rapidity of urinary excretion and the effect upon it of more or less retention. It is safe to assume that practically every operated patient has more or less impairment of his urinary function, the question of catheterization being dependent upon the speed of its recovery and the time which the

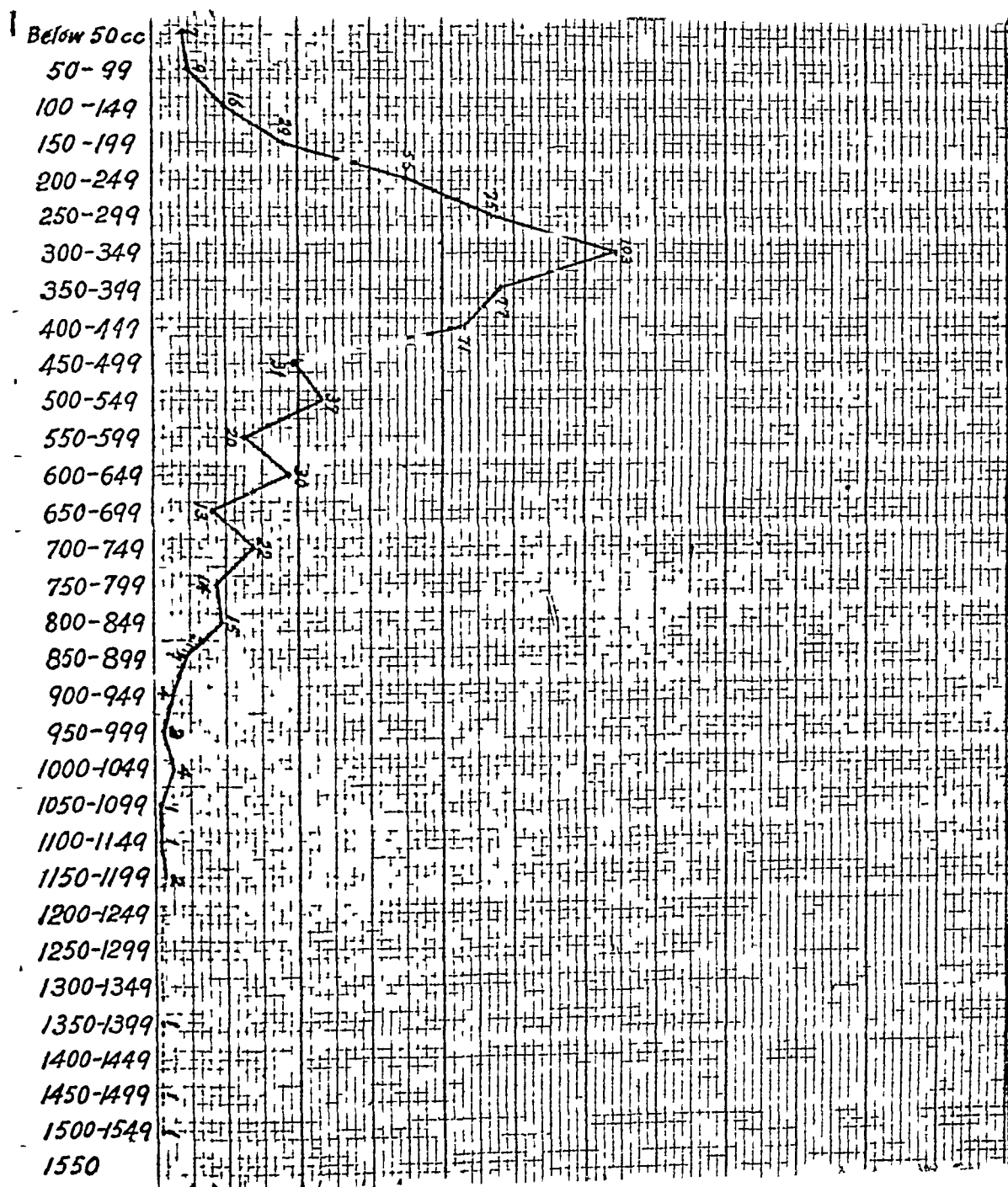


FIG 1—Record of voided specimens

operator is willing to wait for urination to take place. Unfortunately we have no exact information by which to determine whether a bladder wall is really injured by allowing the viscus to fill to a degree quite above that to which it is accustomed. If a bladder which had previously completely emptied itself at each urination were found after such a distention to be unable to do

so, it seems logical to conclude that it had been injured by that distention. Search through the literature fails to find any such systematic search for the presence of vesical insufficiency or investigation of the mechanism by which it is produced. It would seem in the light of our knowledge of the dangers arising from the presence of residual urine that the use of the catheter for diagnostic purposes before operation would be fully justifiable.

Doctor Hunter § states that, "the hospital which has the least post-operative bladder trouble of any institution with which I am acquainted is the Frederick City Hospital. Here Miss Nies, the Superintendent, has for the past twenty years taught her nurses to go to abdominal and pelvic cases five hours after operation, carrying the bed pan, and insisting on the patient voiding at that time. With this display of assurance that the patient is going to void and getting them at a time when the bladder has not had a chance to over-fill, the procedure is almost invariably successful and they do very little post-operative catheterization in that hospital." This illustrates in a striking manner the importance of nervous inhibition in the majority of patients and a means by which it may be overcome. It does not, however, assure one that the bladder has been completely emptied.

The frequency of post-operative urinary retention has not been investigated as fully as its importance would justify. Curtis,⁵ in a large series of major operations on women, found a close connection between the presence of residual urine and the bladder symptoms that led to catheterization. Less than 1 per cent of the patients who were not catheterized for vesical signs of retention had residual urine, whereas more than 64 per cent of those repeatedly catheterized had a residuum of more than 1 oz. The bladder condition usually returned to normal in from four to eight days, but the recovery was greatly delayed by the presence of infection which was limited to the bladder in all but a few cases.

In a previous article the advantages of crowding fluids before operation was emphasized. An abundant supply of fluid is thus provided which should compensate in part for operative loss of blood and produce a physiological polyuria with the more rapid elimination of metabolic wastes. The bladder would fill somewhat more quickly and in case urination was possible would irrigate the urethra earlier and more frequently. Baisch⁶ found that in patients (women) confined to bed and allowed to urinate only twice in twenty-four hours, *B. coli* could be invariably cultivated from the urethra within five days. The multiplication of urethral bacteria was inhibited by increasing the frequency of urination and the total quantity of urine. The histories of these patients did not indicate that the crowding of water had been a routine, but there is abundant evidence that fluids were allowed much more freely than during the period of observation of the St. Luke's series.

Notations of "thirsty" on the charts were unusual, the notable exception being the catheterized mastoid patient who for some unstated reason was denied fluids for many hours after operation. Early giving of water after

§ Personal Communication

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operation, even though it is vomited, is an advantage as it washes out the stomach and hastens the disappearance of nausea.

The literature contains many suggestions as to methods of combating post-operative retention, some of which were found to have been of benefit.

The effect of gravity in the initiation of urination and in the production of residual urine has not been sufficiently emphasized. Barringer and Mackee⁷ found with the X-ray that the bladder is funnel-shaped with the apex corresponding to the urethra. A bismuth suspension had been injected into the bladder for diagnostic purposes and they discovered that they were unable to wash it out as long as the patient was reclining, but could do so readily when he was in the sitting position. This observation suggests the mechanism that undoubtedly assists in the production of residual urine in an atonic bladder. Several of the cases in our series show a wide variation in the amounts recovered by catheter at regular intervals, indicating clearly that the catheter is not to be relied upon to completely empty the bladder. This would be particularly true where a chronically distended bladder formed a pouch on either side of a recently suspended uterus. Nothing short of raising a person in bed until the urethra formed the lowest point would ensure complete emptying of the bladder.

The part played by the act of catheterization in the etiology of post-operative cystitis has been generally misunderstood. In the Wertheim¹⁰ operation for cancer of the uterus, involving as it does extensive dissection of the bladder wall, cystitis has been a frequent and serious complication. It occurred in cases that were not catheterized as well as in those that were. In an effort to decrease the incidence of this complication, Wertheim used special care in the aseptic technic of catheterization, but without appreciably influencing the results. He concluded that the presence of residual urine was the most important factor, a condition made possible by the parietic state of the bladder walls, thus permitting the continued development of bacteria.

Albeck¹¹ reported the results of an examination of 250 gynaecological cases, of which number 130 had residual urine and 120 did not. Of the former group 12 had pyuria, 52 bacilluria and the urine of 12 more contained an occasional organism. Only 16 of the latter group of 120 cases had urine containing bacteria, the remaining 104 being sterile. In these cases no urinary obstruction was present, the walls of the bladder being weakened by age, tumors, or displacements. Thirty-two of these patients were old women, all of whom had residual urine; 11 had pyuria and 13 bacilluria.

In the entire series no record was found of any cystoscopic examination of the bladder to determine the presence or absence of post-operative bladder changes. Presumably the results would have been in agreement with those of Kolischer⁸ who found a "mild desquamative catarrh" quite frequently, especially about the trigone and ureteral openings. He saw no evidence that the actual passage of a catheter had injured the mucosa of the bladder, either at the vesical orifice or on the opposite side where the tip might impinge. Most writers agree that the bladder injury, of whatever extent, is directly

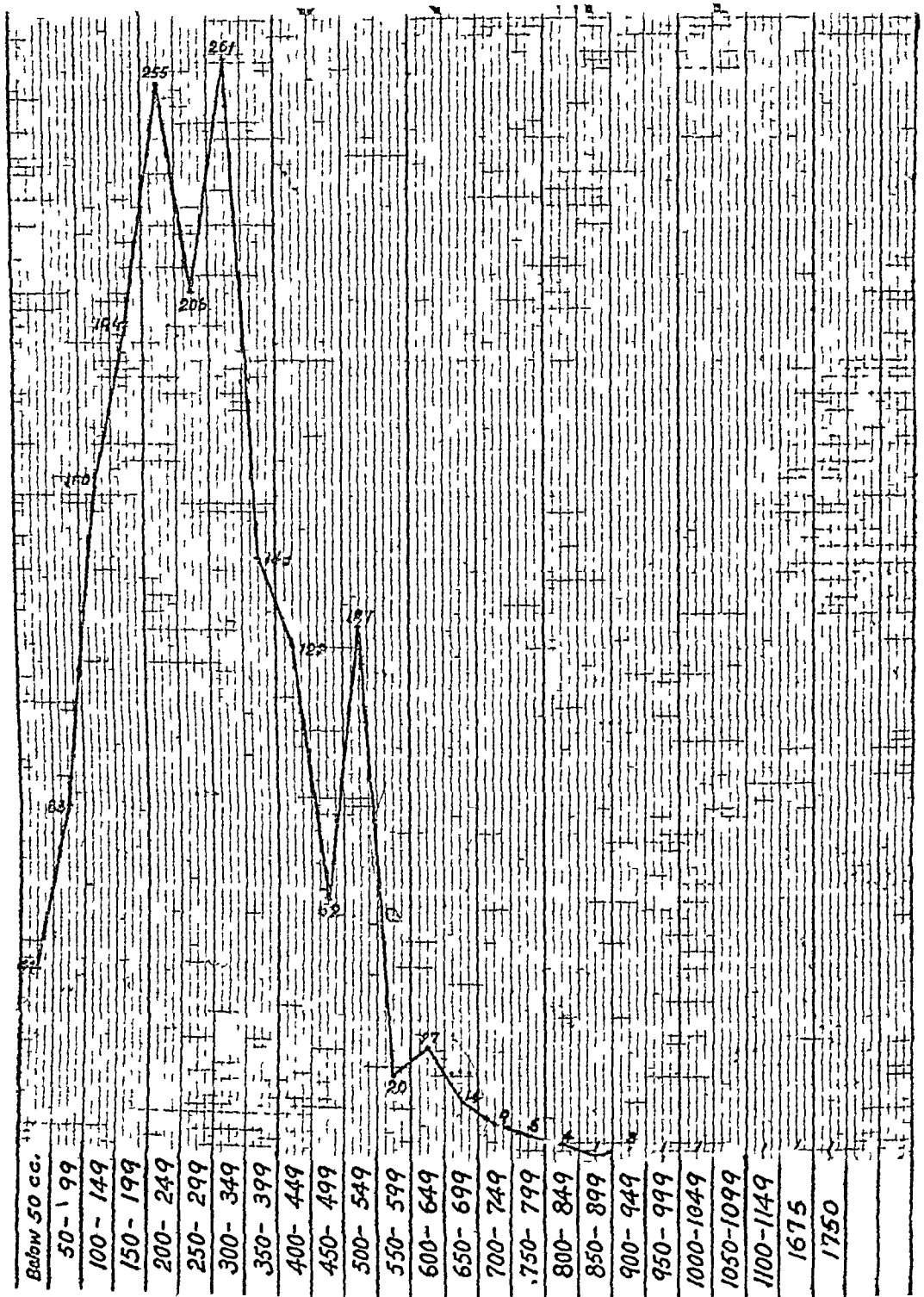


FIG 2 —Record of voided specimens

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attributable to influences from without, either trauma to the walls or interference with the blood and nerve supply, or both, the bladder changes being directly proportional to the extent of the injury and the rapidity of recovery therefrom. General appreciation of these facts has, however, led to alterations in surgical technic whereby unnecessary injury to the bladder wall and adjacent pelvic viscera has been eliminated.

In many instances the records show that catheterization followed shortly after voluntary urination and in some instances several hours after operation, with the recovery of relatively large amounts of urine. In the St. Luke's series the catheter was apparently not used for the diagnosis of residual urine, whereas in the present series it was frequently employed for that purpose. In some instances catheterization and urination alternated in an irregular manner, perhaps for days, until the patient had apparently regained control of the bladder function. This often coincided with the time when the patient was allowed to sit up or get out of bed. This coincidence has been noted by several observers and has led some to urge their patients to sit up much earlier than they might be inclined to do. Jansen⁹ observed that cystitis was less frequent among patients who got out of bed early than those who were longer confined.

The conditions under which bacteria can multiply in the bladder are not fully understood. Kolischer asserts that, with the exception of the gonococcus and diphtheria bacillus, the various pathogenic bacteria do not produce cystitis unless the bladder wall has been previously injured. This may vary all the way from a mild desquamative catarrh to a traumatic cystitis or actual necrosis. These are the physical expression of a functional alteration in the muscular power of the bladder which results in an incomplete emptying of that viscus. Residual urine appearing after operation is usually an indication that the walls of the bladder are so altered that the development of cystitis is imminent. Curtis¹² considers the diagnosis of impaired bladder function of great importance and uses the catheter freely to determine this point. He also follows each voluntary urination by catheterization until complete bladder function has been restored, as shown by the fact that not more than 20 c c of urine can be thus recovered. Copious bladder lavage is employed after each catheterization. Pre-operative examination included a similar test of bladder function.

In the present series of cases there appeared to be a definite effort to ascertain the degree of functional control by means of the catheter, but there was no such systematic control of the situation exercised as advocated by Curtis. The irregularity of catheterization after operation also suggested that the pre-operative bladder function had not been tested, at least in many cases.

In very few instances was the use of the catheter continued after the patient was able to void even relatively small amounts of urine. There was thus no way of knowing whether or not a state of residual urine existed. Taussig says, "the danger of infection lies less in the technic or frequency of catheterization than in the presence of urine stagnation in the bladder."

"Some of my most serious infections occurred in women in whom I had ceased prophylactic measures as soon as they began to void spontaneously" Apparently in the present series of cases very few had any form of local bladder treatment after they were able to void, although urotropin was perhaps continued for a longer period Curtis says, "observance of rigid asepsis seemingly exerts only moderate influence in diminishing the number of such infections" "Another curious fact is that patients catheterized by well-trained nurses suffer from cystitis, while urologists continue to pass catheters and cystoscopes with impunity" Apparently the secret of this paradox is that residual urine is much more frequent in women than in men and that the urethra being short and wide allows bacteria to develop much more freely on its mucosa

Curtis studied catheterization in a fairly large series of gynæcological cases Nearly all of those catheterized several or more times yielded residual urine when tested with the catheter after normal micturition had been resumed This gradually decreased in amount and was usually absent in a week He remarks, "It would seem that no course of procedure is more pernicious than that of the regular use of the catheter over many days followed by abrupt cessation of all catheterization on the assumption that as soon as the patient begins to void the power of thorough evacuation has returned" "Some cases in the series not so closely observed, when tested for residual urine, showed pus in the urine and evidences of cystitis"

He complains of the difficulty of enforcing the rule to catheterize after voiding because of the fear on the part of the nurses of producing a cystitis It would seem that the matter of the routine use of the catheter has been entrusted to nurses too long and that the indications for its use should revert to the house officers who alone are in position to apply it scientifically and for a definite purpose A nurse should not be expected to differentiate distention from a full bladder from that due to other causes, nor should she be expected to use the catheter for diagnostic purposes The actual technic of catheterization of female patients may still remain where it is, but the most skilfully devised routine cannot hope to treat successfully all the varying situations in which the use of the catheter is indicated

Ideal conditions, such as these, are at present difficult to create in most hospitals where rotating interne services bring relatively inexperienced men into immediate charge of post-operative patients This should, however, be considered the goal toward which special efforts may be directed

SUMMARY

1 The post-operative histories of 2254 patients are here summarized, of which 279, or 12.38 per cent, were catheterized These were largely from the gynæcological and surgical services, the former being subject to definite rules as to the time allowed for urination, the latter being governed by individual orders issued by the house staff

2 Comparison with a previous series indicates great advance in surgical

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technic, but no decrease in the percentage of patients catheterized. The frequency with which the catheter was used for diagnostic purposes has greatly increased.

3 The body has been arbitrarily divided into regions and the operations have been grouped and compared. Urinary retention appears to be most frequent in those groups involving the pelvic structures and to decrease in frequency as that region is departed from.

4 Urinary retention is favored by shock and consequent low blood-pressure with decreased output of concentrated urine, by pain, nausea and vomiting, plugs, packing and other mechanical factors, causing perineal pressure and by the presence of a neurotic temperament, having some relation to race and sexual activity. Such difficulty before puberty was not observed.

5 A distinct advance is noted in the freedom with which patients are allowed fluids both before and after operation, as compared with a decade ago.

6 In most cases urination will occur when sufficient fluid has accumulated in the bladder, even though the amount may exceed somewhat the usual content of the viscus. Danger of rupture in the absence of pain is negligible within the first twenty-four hours and the use of palpation and percussion will prevent abnormal distention in most cases. The rate of urine accumulation after operation varies within wide limits, when coupled with uncertainty as to urination *just* before operation and the great difference in the length of operations, any rules for catheterization based upon the time after a patient returns to the ward are open to serious question. The consideration of patients as individuals subject to individual orders rather than in groups would appear to be more logical and lead to less injury from a possible distention of the bladder than when catheterization is left too much to the discretion of the nurses. The actual catheterization of female patients may still be done by nurses, but the responsibility for ordering it should be entirely in the hands of the house staff.

8 The act of urination in bed can be made much easier in many cases by accustoming the patient to the use of the bed pan before operation, by placing the patient in as comfortable a position as possible, free from strain on any set of muscles, particularly those of the perineum, by allowing as much freedom of motion in bed as the operation will permit and by raising the patient as near the vertical position as possible.

9 Women are much more liable to bladder disturbances than men, a condition for which a relaxed perineum is often responsible. Chronic vesical distention with insufficiency frequently follows and is usually indicated by cystocele. Retention in parous women is often due to degenerative changes in the bladder wall, while that in nulliparous women is frequently of neurotic origin.

10 Marriage had no noticeable effect upon catheterization in men, but is clearly of importance in women. The percentage of catheterization of married women was more than twice as high as for single women. The difference was especially noticeable in the women married very young, and became less

marked in the decades following. It appears that a strong sexual instinct, a more or less unstable nervous temperament and bladder difficulties after operation are commonly associated.

11 The white race was probably more liable to urinary difficulties after operation than the colored. The latter seemingly bear moderate pain quite well, but lose control of themselves in emergencies or in severe pain. Colored women whose operations involved the pelvic or abdominal organs were frequently catheterized, but the catheter was not used on a single colored man.

12 Laparotomy and the technic that goes with it was responsible for retention in many female patients, the addition of minor operations on the peritoneum, such as removal of the appendix, having little influence in raising the incidence.

13 In the group comprising operations on the abdominal organs, four times as many women were catheterized as men. Operations on the pelvic organs of women caused retention to a still greater degree.

14 The pressure on the bladder in suspension of the uterus is not ordinarily sufficient to disturb its function unless associated with other operations that compromise its blood or nerve supply.

15 Nervousness in hyperthyroidism was responsible for several cases of retention, but was far less potent in its effect than when associated with pelvic conditions.

16 The importance of residual urine as a predisposing factor in cystitis is being more generally recognized and there were definite evidences that the catheter was used for its detection when the patient voided small amounts of urine.

17 The use of the catheter is indicated before operation for the diagnosis of possible residual urine or to facilitate the procedure, and after operation for the same purpose following the first voluntary urination. If residual urine is found, catheterization should be continued as long as it is present. In such an event, treatment for an anticipated cystitis should be instituted immediately the diagnosis is made.

18 Physicians and nurses should consider that the function of the catheter in post-operative conscious patients within the first twenty-four hours may be the relief of pain due to an accumulation of any amount of urine in the bladder, and is not for the mere mechanical withdrawal of that fluid to prevent a possible overdistention or rupture of that organ except where bladder changes are known to exist or under conditions of pelvic abnormality in women where they are suspected. There is no evidence that a normal bladder distended beyond the ordinary limits is injured thereby and will not immediately return to its former condition after functional control has been restored.

BIBLIOGRAPHY

- ¹ Mills, Ralph G. A Preliminary Study of Post-operative Catheterization. *China Med Jour*, vol xxxv, No 3, May, 1921, pp 217-241.
- ² Mills, Ralph G. A Study of Post-operative Catheterization in Korea. *China Med Jour*, vol xxxv, No 4, July, 1921, pp 310-31.

INCIDENCE OF POST-OPERATIVE CATHETERIZATION

- ³ Hunner, G L, and Lyon, I P The Mensuration and Capacity of the Female Bladder
J H H Bull, vol x, pp 227-9, 1899
- ⁴ Taussig, F J Bladder Function after Confinement and after Gynæcological Operations
Trans Am Gyn Soc, vol xl, pp 351-65, 1915
- ⁵ Curtis, A H Management of the Female Urinary Bladder after Operation and during
Pregnancy J A M A, vol lxxx, No 16, p 1126, Apr 21, 1923
- ⁶ Baisch Erfolge in der prophylaktischen Cystitis. Cent f Gyn, p 380, 1904
- ⁷ Barringer, B S, and MacKee, G M Radiographs of the Bladder and Bladder Neck.
Trans Am Urol Assn, p 408, 1912
- ⁸ Kolischer, G Post-operative Cystitis in Women Am Jour Obst, vol xlviii, p
349, 1903
- ⁹ Jansen Etiologie und Prophylaxe der post-operative Cystitis Inaugural Dissertation
Freiburg, 1913, cited by Taussig
- ¹⁰ Wertheim, E The Extended Abdominal Operation for Carcinoma Uteri (based on
500 operative cases) Trans by H Grad, Am Jour Obst, vol lxvi, No 2, pp
169-232, pl 6, 1912
- ¹¹ Albeck Untersuchungen über die Funktion der weiblichen Harnblase bei Frauenkrank-
heiten In abstr Monatschr f Gyn, vol xxxviii, p 585, 1913 Cited by Taussig
- ¹² Curtis, A H Stasis of Vesical Urine in Relation to Urinary Tract Infections Jour
A M A, vol lxvi, p 1456, 1916

CONCLUSIONS BASED ON A STUDY OF FOUR THOUSAND CASES OF GOITRE

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THE material on which the conclusions in this paper are based consists of four thousand surgical and non-surgical cases of goitre which I have observed during the past five years at the Jackson Clinic, and as a Fellow in Goitre Surgery at the Mayo Clinic. Although these observations are for the most part not new, they are culled from a great mass of facts and for the first time formulated in brief statements.

Advanced cases of exophthalmic goitre are at times treated as endocarditis by heart specialists, as nervous dyspepsia by gastro-enterologists, and as neurosis by neurologists. Little discrimination is made between cases of adenoma of the thyroid with hyperthyroidism and exophthalmic goitre. They are all too generally called "toxic goitre."

The study of goitre is complex, and much confusion exists over the diagnosis and treatment of the various forms. To bring order out of this chaos of opinion, a simple classification is essential, for example: 1. Colloid goitre; 2. Adenoma (a) With hyperthyroidism (toxic adenoma), (b) without hyperthyroidism (simple adenoma); 3. Exophthalmic goitre (Basedow's or Graves' disease); 4. Tuberculosis, malignancy, syphilis, thyroiditis, actinomycosis, and so forth. The usual text-book classification of goitre is confusing. The various clinical types of cystic, calcareous, and hemorrhagic goitre are merely degenerative forms of adenoma.

Colloid Goitre—Colloid goitres appearing at puberty are seen in 60 per cent of girls between the ages of sixteen and twenty in the goitre district of the Middle West.

Factors in the etiology of colloid goitres are: A deficiency of iodine in the soil and consequently in the drinking water, an excessive demand upon the thyroid gland for thyroxin by the muscular, osseous, and especially the reproductive systems at puberty, an undue mental and physical strain imposed upon the thyroid by modern scholastic requirements and social obligations.

The ordinary colloid goitre with its soft globular feel and symmetrical enlargement is easily diagnosed. The vascular type with thrills and bruits, pseudo-exophthalmos, tachycardia, and nervousness must be differentiated from exophthalmic goitre by the absence of true exophthalmos, quadriceps loss, or severe loss in weight. A normal basal metabolic rate confirms the diagnosis of colloid goitre.

In the treatment of colloid goitre, three common mistakes are: 1. The diagnosis is too long delayed and treatment is begun too late; 2. There is no

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uniformity in the method of treatment. 3. Treatment is continued in spite of the development of large adenomas. Colloid goitre may be prevented by administering 10 mg of sodium iodide once a week during the school year, as proved by Marine and Kimball. The treatment of colloid goitre should be begun early, since adenomas tend to develop between the ages of sixteen and twenty. The vascular type of colloid goitre responds most favorably to thyroid extract or thyroxin. Iodine gives better results in the ordinary type. Apparently adenomas develop in neglected colloid goitres as a form of compensatory development. Consequently, the incidence of adenoma of the thyroid is decreased by the prophylactic treatment of colloid goitre.

Adenomas of the Thyroid Adenomas rarely cause symptoms of hyperthyroidism before the age of twenty-five, unless provoked by iodine medication. One in every four adenomas becomes toxic before the patient reaches fifty years of age. One in every five adenomas develops a substernal projection. Five women have adenomatous thyroids to every man that has one. An adenoma is present an average of sixteen years before the onset of toxic symptoms.

The onset of toxic symptoms is both more gradual and insidious in adenoma than in exophthalmic goitre. Toxic symptoms exist an average of four years before the patient with an adenomatous goitre consults a surgeon. The slowly progressive hyperthyroidism of an adenoma causes permanent and serious damage to the heart and kidneys. Myocardial degeneration, as evidenced by irregularities in heart rhythm and œdema of the ankles, is of frequent occurrence.

The popular interest which has been aroused in the treatment of goitre by iodine has greatly increased the number of cases of iodine hyperthyroidism. Iodine is a specific in the prevention and cure of colloid goitre of adolescence, providing no adenomas are present. If in doubt of the presence of an adenoma of the thyroid, do not give iodine. Thyroidectomy is indicated in the majority of patients more than twenty-three years of age with adenomas of the thyroid. In adenoma of the thyroid the gland is asymmetrically enlarged, and one or more nodular tumors may be palpated. In exophthalmic goitre the gland is symmetrically enlarged.

In toxic adenoma acute crises do not occur. Thrills and bruits are rare. Exophthalmos is not seen. The average age of the patient is forty-four years. Hypertension and a disproportionately high diastolic pressure is the rule. The basal metabolic rate averages +38 per cent. Loss in weight and strength, tremor, nervousness, a moist skin, tachycardia, and palpitation occur as in exophthalmic goitre.

Intrathoracic and Substernal Goitre An intrathoracic goitre is one in which the greater part of the enlargement of the thyroid is situated within the thorax. A substernal goitre is one in which there is a projection of only part of the thyroid into the chest. An exophthalmic goitre is never totally

intrathoracic A history of a gradually disappearing goitre, chronic cough, choking spells, difficulty in swallowing, and increasing huskiness of the voice is indicative of a substernal or intrathoracic goitre. One patient in every four has toxic symptoms Dilated veins on the chest occur in 10 per cent of the cases.

Carcinoma of the Thyroid In one series of 100 patients with goitre, observed at the Jackson Clinic during 1923, there were four cases of carcinoma. Three of the patients are now dead The mortality in clinically diagnosed cases of malignancy of the thyroid is 100 per cent. Is there any justification for delaying operation until a clinical diagnosis of malignancy or myocarditis can be made in adenoma of the thyroid? Malignancy does not occur in cases of exophthalmic goitre. An adenoma is a neoplasm, it is potentially a precursor of cancer and should be removed no matter in what part of the body it is located

Exophthalmic Goitre Unlike toxic adenoma, the onset of hyperthyroidism in exophthalmic goitre is acute, the average duration of symptoms being nine months The disease is more common in youth, the average age being twenty-six years, but it may also affect children or the aged. Exophthalmic goitre progresses by acute exacerbations and periods of remission. At the crests of the waves of hyperthyroidism all symptoms are intensified and gastro-intestinal crises occur. Thrills and bruits occur in 80 per cent of the cases Bilateral exophthalmos is observed in one of every two patients within three months of onset of symptoms

The pulse pressure is high, a low diastolic pressure being a very important diagnostic point Loss in weight, in some cases rapid and extreme, is accompanied by a variable and at times excessive appetite Muscular asthenia is most marked in the quadriceps group of muscles. The basal metabolic rate is not an index of the patient's ability to undergo operation, but as a diagnostic aid and a post-operative proof of the result it is invaluable The average basal metabolic rate is +54 per cent Contrary to a generally accepted view, fever is present only during a crisis, hence there should be no difficulty in eliminating the diagnosis of tuberculosis

Pre-operative Measures An examination of the vocal cords should be made in every case of adenoma of the thyroid Laryngeal examination will show partial or complete paralysis of one or both cords in one in every fifteen cases This evidence may prove important from a medico-legal standpoint post-operatively If one cord is paralyzed before operation, especial care must be taken not to injure the nerve supply of the other cord. A Rontgen-ray examination of the chest is of value in eliminating substernal or intrathoracic goitres The two most important pre-operative measures are the choice and the time of operation A severe recent loss in weight and strength with a rapidly rising metabolic rate warns of an approaching crisis If possible, operation should be performed during a remission or early in the

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course of the disease when the weight is stationary or increasing Two cubic centimetres of tincture of digitalis is given to all patients three times a day for three days as a minimum As patients grow weak from lying in bed, they should be allowed to be up from one to three hours daily Thirty grains of bromides daily quiets patients with toxic goitres. A diet of 4000 calories a day is required as a minimum to maintain body weight.

In exophthalmic goitre Lugol's solution reduces the metabolic rate an average of 20 per cent pre-operatively. There is a proportionate clinical improvement, and the necessity for ligation is obviated in 75 per cent. of the cases Lugol's solution and ligation are not indicated in the treatment of toxic adenoma I give two hypodermics before all operations, gr. $\frac{1}{4}$ of morphine, followed in fifteen minutes by gr $\frac{1}{300}$ of scopolamin

Anæsthesia Because of the numerous advantages of the novocain method of local anæsthesia, I use it in 90 per cent of cases The operator and his assistants must handle the tissues most gently and carefully to minimize the sensation of pain and pressure. Any trauma or injury to the recurrent laryngeal nerve may at once be detected by talking with the patient When the operation is finished, undetected bleeders may be found by causing the patient to cough and strain The disagreeable post-operative nausea and vomiting following ether narcosis are eliminated The risk of post-operative hyperthyroidism is diminished There is a decreased chance of post-operative aspiration pneumonia, although pneumonia may occur. The operator can tell whether the patient's condition warrants continuing the operation The disadvantages of novocain anæsthesia are Increased strain on the surgeon; increased psychic disturbance to the patient; increased time required for operating

Operation. Team work rather than individual brilliancy on the part of the surgeon favors a rapid, bloodless resection of the thyroid gland. Time may be gained by preventing hemorrhage from the small vessels in dissecting up the skin and platysma, by applying a very sharp scalpel edgewise and not too deep, while strong traction is exerted by assistants on either side of the flap

Opinions differ on the necessity of dividing the sternohyoid and sternothyroid muscles. Unquestionably it gives better exposure, and whenever this is required as in the case of a vascular, friable exophthalmic goitre or a large colloid adenoma, there should be no hesitation about dividing the muscles Early exposure and anæsthetizing of the upper poles, followed by double clamping and dividing, permits better mobilization of the gland, reduces the factors of shock and pain, and decreases hemorrhage Having properly exposed the goitre by dissecting with the scalpel along the plane of cleavage, one should ligate the lateral veins in order that these vessels may not be torn away and retracted into the wound The recurrent laryngeal nerve must be avoided by placing clamps parallel and not at right angles to it Only the edges of the capsule or the surfaces of the gland are sutured

Post-operative Care. Post-operatively patients must be kept under the influence of morphine for from twenty-four to forty-eight hours, depending on the degree of toxicity. Fluid intake must be kept up to 3500 c c. Digitalin, gr 1/25 hypodermically, may be given every hour if indicated.

Eighty-five per cent of the cases of toxic goitre are cured by surgery. Medical measures may temporarily benefit but only delay the relief possible to obtain by surgery. Rontgen-ray and radium are contra-indicated in the treatment of any type of goitre except exophthalmic goitre. In these cases treatment must be continued over a long period of time and with only uncertain results.

SUBDIAPHRAGMATIC ABSCESS AND ACCUMULATIONS OF FLUID*

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ANATOMICAL conditions in the subphrenic area situated below the dome of the diaphragm make the presence of accumulations of pus or fluid in this region difficult to diagnose, and even after the diagnosis has been made, present several problems of treatment. This is particularly true of lesions on the right side, where the pathological condition most frequently occurs.

Anatomy The ligaments of the liver which are only folds of peritoneum reflected from the liver surface to the diaphragm, divide the subphrenic area into five spaces. The falciform or broad ligament into a right and left area, and the coronary ligament into an anterior and posterior area, while the space between the reflections of the coronary ligaments over the posterior border of the liver forms a smaller extra-peritoneal area. Lymphatic exudate, with the resultant development of adhesions along the anterior border of the liver or at other places, determine, with the etiological factor causing the infection, the location of the abscess or fluid accumulation. The left posterior area forms the lesser peritoneal sac. For all practical purposes this would appear to be a sufficient division of these areas, although Knauth distinguishes a right upper anterior and posterior, a right lower, and a left upper and lower anterior and posterior space. He says, however, that in the majority of cases pus will be found in more than one of these spaces.

Etiology Subphrenic abscess may occur as a pre-operative or a post-operative lesion, usually secondary to a perforative or infectious lesion of one of the abdominal viscera. By far the most frequent causes are appendicitis or perforation of a duodenal or gastric ulcer. Less commonly the gall-bladder, liver, biliary ducts, pancreas, kidney, colon, a residual peritoneal infection of hæmatogenous origin as reported by Eliot, an abscess of actinomycotic origin (Case VI,) the ribs, or even a previous lesion above the diaphragm, may act as the exciting cause.

Pathology The pathological condition developing will depend on the exciting cause. As most of the infectious visceral lesions occur on the right side, the abscess or collection of fluid is most frequently found under the right vault of the diaphragm. An extension of the infection from an acute appendicitis may travel alongside the colon by direct extension of the lymphatics usually to the right posterior space, or in a high appendix the anterior space (Case I.)

Infection from the appendix extending upward behind the ascending colon may reach the retroperitoneal space between the liver, diaphragm

* Read before the New York Surgical Society, March 26, 1924

and reflections of the coronary ligament In a lesion of such nature, the abdomen if opened in front, would show no peritoneal involvement, the abscess lying entirely retroperitoneally

Perforated duodenal or pyloric ulcers result in a spread of the infection from below the liver, until the accumulation of fluid lies above the liver and below the diaphragm on the right side, in a position determined by the rapidity of the formation of adhesions (Cases IV, VII, VIII and XI) Perforations of the posterior wall or high on the lesser curvature of the stomach, which usually become adherent to the liver or pancreas may result in fluid exudations into the lesser sac, as may also occur secondary to an abscess of the pancreas

Following the perforation of a duodenal ulcer, a litre or more fluid may accumulate This of course is not all fluid which has escaped from the perforation, but is largely the result of peritoneal exudation caused by chemical irritation as well as low grade bacterial infection The amount of this fluid and its position is determined by the formation of adhesions, the direction of its flow, and the size and subsequent closure of the perforation

With the occurrence of a perforation anywhere along the gastro-intestinal tract, there is usually an escape of some air or gas This may be very small in amount and the large amounts of gas frequently found in subphrenic abscess are largely the result of gas forming anaerobic bacteria such as the colon bacillus (Cases III, IV, XI) The side of the diaphragm affected is pushed upward, but not always in its entirety, that is, the anterior or posterior portions or that part closer to the midline and away from the axillary line, may be especially elevated, (Case XI) It does not move up and down normally with respiration The liver is usually pushed down or may be very little displaced, even with a considerable quantity of fluid and air between it and the diaphragm Secondary empyema may occur, or there may be a considerable quantity of clear fluid in the pleura, coincident with pus below the diaphragm, (Cases VIII and XI)

Symptoms and Diagnosis These variables mentioned under pathology make difficult the diagnosis, particularly confusing the physical signs Following an operation for suppurative appendicitis or perforated duodenal or pyloric ulcer, the symptoms due to peritoneal irritation or infection continue or subside and then reappear after a number of days, usually gradually, (Case III) It is apparent that there is infection or pus somewhere and the difficult problem is to locate it When the pathological condition occurs before operation, but secondary to a slow or small duodenal or pyloric perforation after a more or less acute onset of hypogastric or right-sided pain, the symptoms of the subphrenic abscess may develop more gradually and point to other conditions In one case the acute right-sided pain radiated to the penis and seemed to point at first to a renal or ureteral colic, although the rigidity indicated peritoneal inflammation. (Case IV)

Usually when secondary and frequently when primary the condition is mistaken for some pathology above the diaphragm This because a post-

SUBDIAPHRAGMATIC ABSCESS

operative pneumonia is unfortunately not infrequent and is always looked for when a post-operative case does not do so well and because the physical signs resemble so closely a pulmonary or pleural inflammation. Also, because of the frequency with which a patient with a beginning pneumonia complains of abdominal pain.

As usually described, the physical signs found are dulness or flatness, diminished breath and voice sounds and vocal fremitus with the presence of râles over the base of the lung. The area of dulness is characterized by being convex upward and not changing its area with a change of position of the patient. When gas is present in the abscess cavity, there are three zones of different resonance on percussion, normal above, tympany caused by the gas below this, and the area of flatness caused by the pus, which is continuous with the liver dulness on the right side. When there is also fluid in the pleura an area of flatness forms a fourth zone between the pulmonary resonance and the tympanic zone caused by the gas beneath the diaphragm.

These are the classical signs recorded and would probably be present if each layer or zone were superimposed on each other evenly like a pile of books or a layer cake, but they are not, and frequently the physical signs become most confusing. The causes for the variations from the above classical signs and the reasons for confusion are

(1) The fluid is not evenly distributed between the liver and the diaphragm, but being localized in a smaller area raises the diaphragm in a conical manner and is overlapped anteriorly, posteriorly or laterally by lung tissue.

(2) In the same manner, gas occupying the upper part of such an area is overlapped by lung tissue, or lies partly behind or in front of the liver.

(3) With a large accumulation of fluid pushing the diaphragm upward, the physical signs over the lung above are not those found over a normal lung but those of compression and closely resemble the physical signs of pneumonia or fluid in the pleural cavity.

(4) The air or gas in the cavity may be so small in amount that it causes no zone of hyperresonance, but may be just enough to mask the flatness or dulness.

(5) A marked amount of post-operative abdominal distention may push up the diaphragm sufficiently to cause all the physical signs of a subphrenic abscess.

(6) The usual physical signs closely resemble a pleurisy with effusion or empyema, and injudicious exploration with an aspirating needle may enter the subdiaphragmatic abscess and on withdrawal infect the pleura. Then the original lesion is masked by the empyema or pyopneumothorax which develops.

In addition to these conditions which mask or confuse the physical signs, there are other symptomatic findings which may not conform with the expected. Tenderness may not be elicited for obvious physical reasons. A considerable accumulation may be so well walled off that there may be

little absorption and therefore no or little temperature elevation or leucocyte increase, (Case XI) An exploratory needle puncture may pass through the elevated diaphragm and obtain pus which would appear to come from the pleural cavity. The needle may enter the cavity but only where gas is present and no pus be obtained. Cottle has reported a case in which a subphrenic abscess developed after the removal of the appendix and the excision of a duodenal ulcer. For three and one-half months there was lack of unanimity of opinion as to the diagnosis. The roentgenologist was persistent in his original statement that the fluid was probably in the abdomen but the physical signs and other clinical evidence failed to bring agreement. About four months after the abdominal operation, aspiration was performed and this showed that the pus was in the abdomen, not in the chest. Operation confirmed the diagnosis of subphrenic abscess.

Rontgenographic study with the fluoroscope and films is the best method not only of confirming or making the diagnosis, but also of determining the position and size of the fluid accumulation. Even this, however, may result in misinterpretation. It is most important that the examination be made in the erect position or sitting up, and if the patient is too ill to allow this, lying on the side opposite the lesion. This will allow the gas in the cavity to reach the highest point and often show a fluid level in the cavity. Failure to do this has resulted in a wrong diagnosis, which becomes simple on repeating the examination, (Case IV). While the fluoroscope may determine the position of the abscess and its antero-posterior as well as lateral relations, stereoscopic films are a great aid to the surgeon to determine his point of approach to the lesion.

A final word on diagnosis might be said concerning exploratory puncture. I believe that this should always be reserved until careful X-ray study has been made, if subphrenic abscess is suspected. Then it is often unnecessary. If done before as frequently happens, either no pus is found or if found, the withdrawal of the needle frequently involves the pleura, causing empyema or pyopneumothorax.

Operative Treatment Drainage. Careful radiographic study should determine the best line of approach to the abscess for the purpose of drainage. When the X-ray shows this to be in front, especially if the history and signs point to a recent duodenal perforation, a high anterior right rectus incision will usually allow the best method of exploration and drainage, (Cases IV and VIII). This incision is recommended as the subphrenic abscess is apt to be associated with accumulation of fluid below the liver and about the duodenum. Incision parallel with the free border of the ribs as advocated by some would appear to be particularly likely to be followed by a hernia most difficult of repair, if infection of the wound follows the drainage.

Posterior abscess is best approached by resection of the tenth rib in the posterior axillary line, under local anæsthesia. If done carefully, this may usually be accomplished without injury to the pleura which is carefully pushed upward, the costophrenic space entered and the diaphragm seen.

A large aspirating needle is then pushed through the diaphragm, the pus located and a small opening made in the diaphragm which is enlarged by stretching with scissors so that a large rubber tube may be introduced. If the pleura has been accidentally opened, and it contains no fluid, it should be closed and the wound packed with gauze for twenty-four to forty-eight hours to allow adhesions to wall off the pleural cavity from the drainage tract before going through the diaphragm to enter the abscess, (Cases IX and X).

If empyema of the pleura is already present, the pleura may be drained by means of the usual resection of the seventh or eighth rib, and the abscess below the diaphragm approached by resection of the tenth rib in a different line or else both the pleura and the subdiaphragmatic space drained through the same incision, the latter opened twenty-four hours or more after the former, (Case XI).

It is also well to keep in mind, the necessity of continuing drainage for a sufficient time and the danger of the abscess cavity again becoming walled off if drainage be discontinued too soon or abruptly (Case I). In my opinion this is one of the very few occasions when tube drainage is indicated for drainage of pus or fluid below the diaphragm.

CASE REPORTS

CASE I—G S, female, age thirteen, entered St Luke's Hospital, July 31, 1911. Acute gangrenous appendicitis. High appendix with undescended cæcum, and abscess under liver. Adhesions between liver and diaphragm separated and pus evacuated and rubber dam drain inserted. Temperature fell but rose again and physical signs were present over base of right lung. The X-ray showed subphrenic abscess had again become walled off. Separation of adhesions and insertion of rubber tube well above liver caused profuse discharge. Ten days later this drainage again became obstructed. Temperature 103. Patient septic and jaundiced. Separation of adhesions again allowed free drainage. This was repeated four days later after which patient recovered.

CASE II—M P, male, age eight. Englewood Hospital, November 7, 1910. Operation for acute appendicitis with general peritonitis. Temperature between 99° F and 100° F for ten days after operation. On fourth day complained of pain in left chest. Examination showed râles over left base behind but no other physical signs. On tenth day temperature rose to 104.3 and pulse to 180. The wound examination was negative and two consultants were unable to find any other physical signs than the previously mentioned râles over the left chest. No X-ray was taken. At 8 A M on the 12th day he developed a harrassing cough with scanty expectoration. One hour later there occurred a profuse enormous purulent expectoration which became bloody as œdema of the lungs developed, and he died in a little more than an hour, apparently drowned by the pus in the lung. The pus showed streptococci and a bacillus apparently the B. Coli. While not proven, it is believed that this was a left-sided subphrenic abscess rupturing into the lung and causing death.

CASE III—D K, male, age twenty-two, operated on at St Luke's Hospital for perforated duodenal ulcer, July 19, 1921, eight hours after perforation. Convalescence uneventful until August 11, when temperature began to rise. It reached 106 after a chill six days later. No signs of infection over wound. Dulness and diminished voice and breath sounds over right base. X-ray examination showed right side of diaphragm elevated but abscess was not located. On August 8th the radiograph showed two small gas bubbles between the liver and diaphragm. Three days later these gas areas had

increased in size, easily locating the abscess, which was drained by resection of the 10th rib under local anæsthesia

CASE IV—I N, male, age twenty-seven Admitted to Knickerbocker Hospital, January 2, 1924 Developed acute pain over entire upper abdomen on day of admission Most marked on right side and radiating down into penis, suggesting right renal colic, although abdominal rigidity seemed to contradict this and suggested perforated duodenal ulcer Temperature 99.2 Pulse 96 Leucocytes 11,000 Polymorphonuclears 76 per cent The following day the temperature, pulse and leucocyte count had risen and there was marked dulness and flatness with bronchovesicular breathing and voice sounds over right base X-ray diagnosis made of beginning pneumonia on right side, although pain, tenderness and abdominal rigidity persisted It was then suggested that the radiograph be taken with patient on his side, which confirmed the diagnosis of subphrenic abscess, containing gas Even then, as the patient's chest had been aspirated and pus obtained, the diagnosis of empyema was persisted in by the medical consultant who induced the operator to explore the chest before opening the abdomen The pleura was explored after rib resection under local anæsthesia, and no fluid found A right rectus incision was then made by Dr C A Frink, and a large amount of foul-smelling fluid found about the duodenum and under the liver and running down into the right kidney region There were adhesions along the anterior border of the liver which when separated allowed the escape of another large quantity of similar fluid Drainage was established but this patient died five days later

CASE V—C B, female, age forty-seven Admitted to Knickerbocker Hospital, January 15, 1924 She was shot with a revolver The bullet passed in and out through the right breast and entered the chest wall just above the costal margin in the mammary line X-ray showed it to be located about 2 cm to the left of the 10th dorsal vertebra The patient had a complete motor paralysis of both legs from Poupert's ligament down, with the exception of the right adductor group Sensation lost in left leg but present in right There was marked dulness and diminished breath and voice sounds over the right base Radiographic examination showed the diaphragm pushed upward to the level of the 5th rib, and allowed a diagnosis to be made of effusion of blood between the liver and diaphragm instead of a hæmothorax caused by the passage of the bullet The signs of this fluid gradually disappeared without treatment

CASE VI—M D, aged fifty, female, was seen in November, 1913, complaining of pain under the left costal margin with a dry hacking cough and no expectoration, and running an irregular temperature which sometimes went as high as 104.5, with night-sweats There was dulness, diminished breathing and voice sounds over base of the left lung posteriorly There were no râles After several attempts at exploration with the needle, pus was found by consultant. It was not determined whether it came from above or below the diaphragm It was sterile on smear and culture X-ray showed left diaphragm elevated and having a diminished excursion She was operated on November 25, 1913, in the Polyclinic Hospital Resection of the tenth rib, along the posterior axillary line, showed the diaphragm thickened Aspiration through the diaphragm demonstrated pus The abscessed cavity was drained Pus was sterile A section removed from the diaphragm showed actinomycosis After treatment with potassium iodide, patient was discharged cured This case was reported in the ANNALS OF SURGERY, vol 1x, 1914, p 389

CASE VII—W R, male, age twenty-six, was admitted to the medical ward of St Luke's Hospital, October 31, 1916 He gave a history of acute abdominal pain on the right side the day before admission A similar attack of three days' duration occurred two and one-half years previously Physical signs over the right base caused a diagnosis of "lobar pneumonia" (?), although the history stated that the patient vomited dark brown fluid several times on the day of admission and had marked tenderness and rigidity ("voluntary"?) over the right upper quadrant He was treated with mustard paste to chest and flaxseed poultices to the abdomen, Murphy drip and colon irrigations X-ray

on November 1st showed no pneumonia and gas was demonstrated underneath the diaphragm. A mass then appeared in the right upper quadrant, extending from the lower border of the ribs to the umbilicus. He was transferred November 8th, eight days after admission, to the surgical side for operation with a diagnosis of "abscess, secondary to perforated duodenal ulcer." He was kept on the surgical side for three days longer, during which time a cystoscopic examination was done to determine the condition of the right kidney.

Operation was done November 11th by Dr. Walton Martin, right rectus incision, at the level of the umbilicus. Abscess cavity containing several ounces of foul-smelling pus evacuated. Culture showed short chain streptococci. Discharged December 3rd. A radiograph taken on December 2nd showed duodenum not filled, indicating ulcer or adhesions.

CASE VIII—C. H., male, age thirty-four, admitted to the medical ward of St. Luke's Hospital on June 22, 1920. Acute pain in right abdomen two weeks before admission, began in right lower quadrant, and then extended to right upper quadrant. Temperature after admission ranging from 100–104. Pulse 72–104. Had bad teeth but no history of gastric disturbance since 1917. In 1916 had operation for acute appendicitis, and was operated on for acute obstruction in 1917. Physical signs over right base caused diagnosis of "pleurisy with effusion." Exploratory puncture of right pleura showed 15 cc of bright fluid which looked like changed blood. June 23rd, X-ray diagnosis of fluid in right chest cavity. Thirty-four ounces of clear yellow fluid was withdrawn. June 25th, tender mass appearing below costal border of ribs anteriorly. Tympanitic note over mass. July 1st, X-ray shows gas under diaphragm, suggesting subphrenic abscess, also probably fluid in chest cavity. July 2nd, exploratory chest puncture. No fluid obtained. July 3rd, transferred to surgical side for operation. July 4th, operation by Dr. Richard Bolling. Tenth rib resected and exploration done with needle downward found air but no pus. Right rectus incision then made which revealed large abscess extending over upper surface of liver as far as could be reached with the hand. This was drained and patient left hospital four weeks later. Before leaving, the radiographic examination of the gastro-intestinal tract showed a twenty-four-hour stomach retention and deformity of the duodenum, indicating probable cause of abscess as duodenal perforation.

CASE IX—M. V., female, age thirty-three, admitted to the medical ward of St. Luke's Hospital, September 6, 1916, with a history of four months' pain in the right hypochondrium and upper abdomen. Two months before admission had an attack of jaundice with vomiting. No cough up to two or three days before admission. Temperature ranged between 101 and 106. Physical signs over base of right chest caused diagnosis of "acute pleurisy with effusion." Aspirated on day of admission, one-half ounce of clear fluid obtained. The following day five ounces of dark bloody fluid obtained. September 18th, 15 cc of dark brown, very thick pus. X-ray report September 8th, "There is a dense shadow involving the right side of the chest and displacing the heart to the left. The exact nature of the shadow is hard to determine, but is dense enough to indicate fluid, although no definite fluid level is observed in this position." Transferred September 9th to the surgical side with diagnosis of empyema. Operation September 9th, Dr. M. K. Smith, rib resected two and one-half inches below angle of scapular. No fluid in pleura, but exploration with needle through diaphragm obtained pus. Seventy-two hours later second operation done through original incision. Diaphragm opened and echinococcus cyst of the liver drained. November 1st, X-ray showed the diaphragm remains very high on the right side and there is a diffuse shadow involving the lower chest on this side.

CASE X—M. P., female, age seven. Admitted to St. Luke's Hospital, private patient of Dr. F. S. Mathews, October 10, 1917. Had been ill three weeks. Abdominal symptoms at first, later thought to be pneumonia. Aspiration through chest got foul-smelling pus. Liver prominent in epigastrium. Lung signs not marked. X-ray shows fluid and gas apparently below diaphragm. Diagnosis of subphrenic abscess made by Doctor Mathews. Tenth rib removed. Pleura opened. Wound packed and diaphragm opened.

two days later Large pus cavity found between liver and diaphragm Five months later patient again admitted to the hospital and operated on for acute appendix abscess

CASE XI—E M, male, age sixty-six, was admitted to the surgical ward of St Luke's Hospital on November 25, 1923, service of Doctor Downes, with a diagnosis of "acute abdominal condition" He had been suffering from severe abdominal pain for twenty-four hours Pain came on suddenly, was worse in the right upper quadrant and required morphine for relief No vomiting He had suffered from heart trouble with anginal pain in chest and arms for the past five years, was told that he had lead colic several years ago, but had never had so severe an attack of abdominal pain before About three months before admission he had pneumonia and said he had never felt quite well since Physical examination showed general abdominal tenderness and board-like rigidity, most marked in right upper quadrant No masses felt There was dulness over the right base and râles in both lungs Enlargement of the heart to the left with a systolic murmur at the apex On account of patient's cardiac and possible pulmonary condition, it was decided not to operate Urine contained many hyalin casts His abdominal pains disappeared Leucocytes dropped from 16,800 to 9000 and he was quite dyspnoëic and irrational at times Medical consultation held and patient transferred to medical service, with a diagnosis of "nephritis of nitrogen retention type" His temperature after transfer became elevated, and on November 30th, five days after admission to the hospital, fluid was found in his right chest and 360 c c of straw-colored fluid withdrawn This culture showed staphylococcus albus On December 12th, twelve days later, a radiograph was taken, showing evidence of a cavity with fluid level on the right side and gas probably below the diaphragm He was then transferred back to the surgical ward on December 23, 1923, eleven days later The following day a thoracotomy was done by Doctor Downes, the cavity containing very foul gas but very little fluid or pus Drainage tubes were inserted in the cavity which drained moderately Temperature came down and condition improved Subsequent X-rays showed drainage tubes not in the original cavity and a probe passed through the drainage tract enters the chest cavity to the outer side and behind the original abscess cavity January 7, 1924, a second operation was performed through the original incision, at which had been resected apparently the eighth rib On entering this wound the finger entered a cavity, which was separated above from the general pleural cavity which had previously been opened, by a thin layer of tissue which the writer believes was the parietal pleura forming the upper boundary of the costophrenic sinus A more dense layer of tissue forming the floor of this cavity was opened into and a large cavity containing foul pus and gas was entered The operator was not able to determine whether this tissue passed through was diaphragm The cavity was drained The abscess diminished in size and the X-ray then showed that the fluid level had disappeared The upper part of the cavity moves with respiration as shown by the fluoroscope, probably indicating that this is diaphragm" A subsequent gastro and intestinal series on January 23, 1924, was of no aid in clearing up the diagnosis On discharge the only X-ray findings was a small amount of thickening in the region of the costophrenic sinus An X-ray since discharge shows that this has almost disappeared

SUMMARY—There are eleven cases reported Of this nine were on the right side, two on the left Seven were males, four females Nine recovered, two died Eight occurred as a pre-operation lesion, three post-operatively as a complication during convalescence Five were probably the result of perforated duodenal ulcer, although this was not always proven, three of appendicitis, one due to actinomycosis, one to echinococcus cyst of the liver, and one to a bullet wound of the upper portion of the liver

In the study of these cases one is impressed with the fact that there was, in most of the cases, a mistake or at least a delay in the diagnosis, due to the belief that the lesion was above the diaphragm In six of the acute cases

there is a distinct history of severe abdominal pain, often accompanied by rigidity and sometimes by vomiting. In one case of coffee ground material. In most of the cases the X-ray showed an elevated diaphragm and usually gas below the diaphragm or would have shown the gas, if properly taken. However, the physical signs over the base of the lung, usually due to compression by the elevated diaphragm and mistaken for pneumonia or fluid in the pleura, or to fluid which had accumulated in the pleura secondary to the infection below, caused the evidence of an abdominal lesion to be disregarded. Only so can these mistakes and delays be explained.

It is therefore believed that such mistakes and delays and secondary chest infections from needle explorations would occur less often if. First, it is kept in mind that compression caused by fluid below the diaphragm may cause physical signs closely resembling a lesion in the chest, second, the symptoms of an acute abdominal lesion be given their true significance; third, radiographic study repeated if necessary, and made in the erect, or if this seems unsafe, in the lateral posture be carefully carried out.

The writer thanks Doctors Martin, Downes, Mathews, Bolling and Smith for permission to include cases operated on by them, in this paper, and also Dr L. T. Le Wald for the use of several lantern slides from his collection in presenting this paper to the New York Surgical Society.

REVIEW OF FIVE THOUSAND FOUR HUNDRED AND EIGHTY-EIGHT APPENDECTOMIES PERFORMED AT THE LANKENAU HOSPITAL OF PHILADELPHIA

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THERE are certain subjects in medicine which owe their interest to their unusual and rare incidence, while others attract attention because of their frequency. It would be perfectly logical to infer that the latter class would present few difficulties of diagnosis and of treatment. But the theory in this instance does not conform to the fact, as far as so common a disorder as appendicitis is concerned. Owing to the ability of the appendix to mimic other abdominal disorders, which in turn is in large measure due to the tendency of the organ to deviate in position from its normal location in the right iliac fossa, the diagnosis of appendicitis continues to present difficulties both to the experienced and the tyro in diagnosis. However, if it is remembered that appendicitis is undoubtedly the commonest acute pathologic process met with in the abdomen, and if the sequence of symptoms—Pain, vomiting, tenderness in the right iliac fossa, fever and leucocytosis—is kept in mind, fewer mistakes in diagnosis should result. In the majority, if not in all instances, the pain precedes the vomiting. Abdominal pain with tenderness in the region of the appendix is of far greater value from a diagnostic standpoint than an increase in the pulse rate, temperature and leucocytes, although occasionally a rise in the leucocytic count is of great aid in the diagnosis. The importance of making a vaginal and rectal examination in cases of acute abdominal pain should be emphasized. Occasionally there is slight tenderness in the right iliac fossa, either with or without tenderness in the left iliac fossa, and in such instances a rectal examination will disclose acute tenderness from an inflamed appendix lodged in the pelvis. The following history will illustrate this point. A young man twenty-five years of age had had three attacks of acute pain in the abdomen following indulgence in alcohol. The pain was generalized throughout the abdomen and accompanied by vomiting, the vomitus occasionally containing blood. There was slight tenderness in the epigastrium, and slight rigidity of the upper recti. A rectal examination was not made. The diagnosis was subacute perforation of a gastric ulcer. An upper abdominal incision revealed the stomach, duodenum, and gall-bladder to be normal. A rectal examination was made, a mass was palpated through the right rectal wall, this proved to be a gangrenous appendix, which was removed through a low right rectus incision.

Acute appendicitis may be accompanied by diarrhoea, although it is not

common, but in any case of acute pain in the abdomen associated with diarrhoea, the appendix should be thought of.

It is the custom in the Lankenau Hospital, in the absence of complications, to operate immediately on all patients seen in the first thirty-six hours, but where the symptoms are of longer duration the procedure varies. In the presence of a spreading peritonitis immediate operation is contra-indicated. These patients are best treated by placing them in the sitting position, with an ice bag to the abdomen, administering proctoclysis with normal saline solution, together with hypodermoclysis and moderate doses of morphia, and giving nothing by mouth. The saturation of the patient with opium, as advocated by some surgeons, seems a poor method of treatment. In 1918, we advocated non-interference in this type of case until localization had occurred. W. J. Mayo, as well as Jopson and Pfeiffer, have recently expressed similar opinions. Jopson and Pfeiffer say "Now we

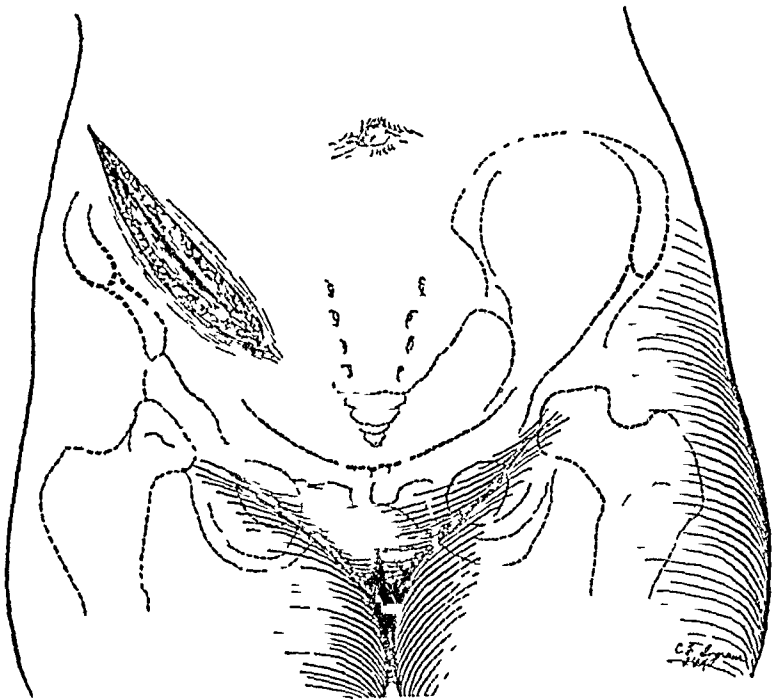


FIG 1 —Incision for the extra-peritoneal approach to the appendix

know that by far the greater part of the mortality from appendicitis comes from the group which exhibits when first seen a widespread peritonitis with evidences of profound systemic toxæmia, and usually in the third or later days of the disease. Leaving aside the question of elimination of this type of case by more timely recognition, it is evident that the reduction of surgical mortality must deal chiefly with this group. Those who have made use of Ochsner's Fowler-Murphy plan cannot fail to have been impressed with the general improvement, and localization of the peritoneal process that may occur in seemingly desperate cases. Nor can they have failed to note that other cases exhibit no such tendency but proceed to generalization and death. On the other hand, those who practice immediate operation must often have had the experience that the post-operative condition of the patient is obviously worse than before operation, and death results from progressive toxæmia, within a few hours or days. * * * On the other hand, there are certainly cases that show no tendency towards localization and will inevitably perish under any waiting policy. In the body of this paper we have made a plea for recognition of certain types which are likely to fall into this group, notably (1) young children, (2) cases of delayed and fulminating gangrene or perforation, and (3) intra-abdominal rupture of a localizing or localized abscess."

In the cases seen in the first few hours a McBurney, or a low right rectus incision may be used. If there has been a spreading peritonitis with localization, the incision will depend somewhat on the position of the abscess. If there is a mass in the right iliac fossa, the extraperitoneal approach, as used by us, is of advantage. The incision (Fig 1) begins about 4 cm behind the right anterior superior spine of the ileum and extends down over the mass approximately parallel to Poupart's ligament. The muscle fibres of the oblique and the transversalis muscle are cut transversely, and the abscess

approached from the lateral side. After the peritoneum is opened the small intestines (Fig 2) are carefully packed towards the mesial side, and the appendix and cæcum are disclosed with the abscess. The appendix is removed in most cases with; but sometimes without, inversion of the stump, depending on the pathologic condition present. A glass tube is passed into the pelvis, through which fluid, if present, is aspirated. Also any extension into the subhepatic fossa is noted. Drainage is then instituted (Fig 3), usually

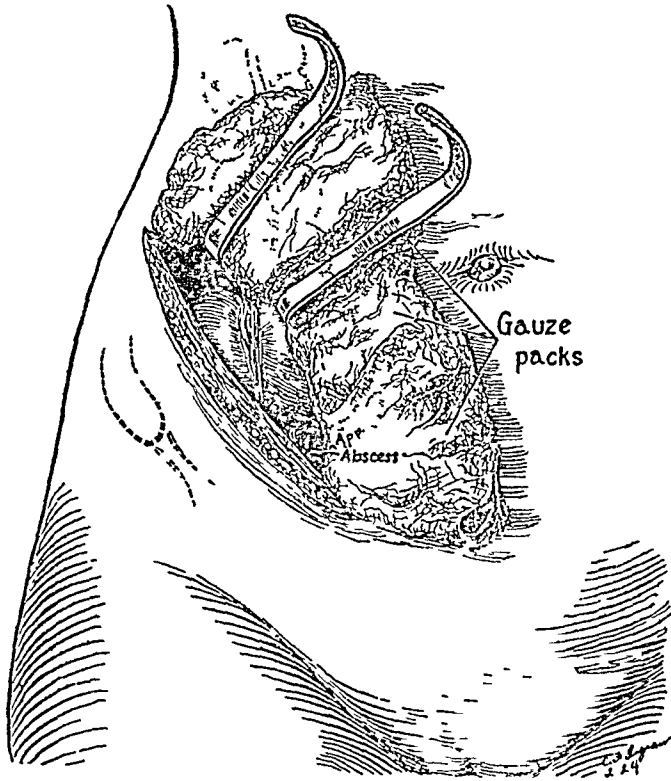


FIG 2—Method of walling off appendix and cæcum

with cigarette drains, one being passed to the pelvis, one along the external surface of the ascending colon, and one to the stump of the appendix. A small piece of gauze is then wrapped around the drains and the wound loosely closed with through-and-through interrupted sutures of silkworm gut. Another piece of gauze may be placed in the wound. The wound is kept moist with Wright's solution. In from four to six days, one drain is removed, and a small rubber tube introduced in its place. This is repeated in the succeeding days with the other drains, and the wound is irrigated with a saline or weak carbolic solution every day. The wounds usually heal by granulation and without complications. It is possible that this incision may be followed by a higher percentage of post-operative hernias than the type usually employed. We believe, however, that its advantages far outweigh this fault, as the hernia may later be repaired with comparatively little risk. The drainage described will, of course, vary with the areas involved in the abscess. In cases in which there is no mass, or in which the mass is near the middle of the abdomen, a

low right rectus incision can be made. The post-operative treatment is essentially the same as the pre-operative.

It may be well here to protest against the exploration of the upper abdomen in the presence of a gangrenous appendix and abscess. While an associated lesion, such as perforation of the gall-bladder, or peptic ulcer, or Meckel's diverticulum, may occasionally occur, in our experience this is not common. If the condition of the appendix is not sufficient to account for the symptoms, exploration is certainly advisable, but in the presence of an abscess the indiscriminate exploration of the abdomen is disastrous. The clinical findings also will aid in the elimination of multiple lesions.

During the years 1900 to 1920, 5488 appendectomies were performed in the Lankenau Hospital for acute appendicitis, with 327 deaths, a mortality of 5 per cent. These operations divided into five-year periods give data as follows:

In 1901, 135 cases with twenty-six deaths, 19.2 per cent.

In 1902, 271 cases with thirty-seven deaths, 13.6 per cent.

In 1903, 268 cases with twenty-two deaths, 8.2 per cent.

In 1904, 395 cases with twenty-five deaths, 6.3 per cent.

In 1905, 289 cases with thirty-three deaths, 11.4 per cent.

Thus within the years 1901 to 1905 there were 1358 operations with 143 deaths, a mortality of 10.5 per cent. It was the custom, in this period to operate on all patients suffering with acute appendicitis when first seen, regardless of the extent of the disease. In the next five years many of the patients with spreading peritonitis were treated expectantly by the Fowler-Murphy-Ochsner treatment, but it was not until 1910 that this treatment was instituted in all cases of spreading peritonitis.

In the years 1906 to 1909 there were 1159 operations on patients with acute appendicitis with sixty-five deaths, a mortality of 5.6 per cent.

In 1906, 317 cases, fifteen deaths, 4.7 per cent.

In 1907, 315 cases, fifteen deaths, 4.7 per cent.

In 1908, 266 cases, seventeen deaths, 6.2 per cent.

In 1909, 261 cases, eighteen deaths, 6.9 per cent.

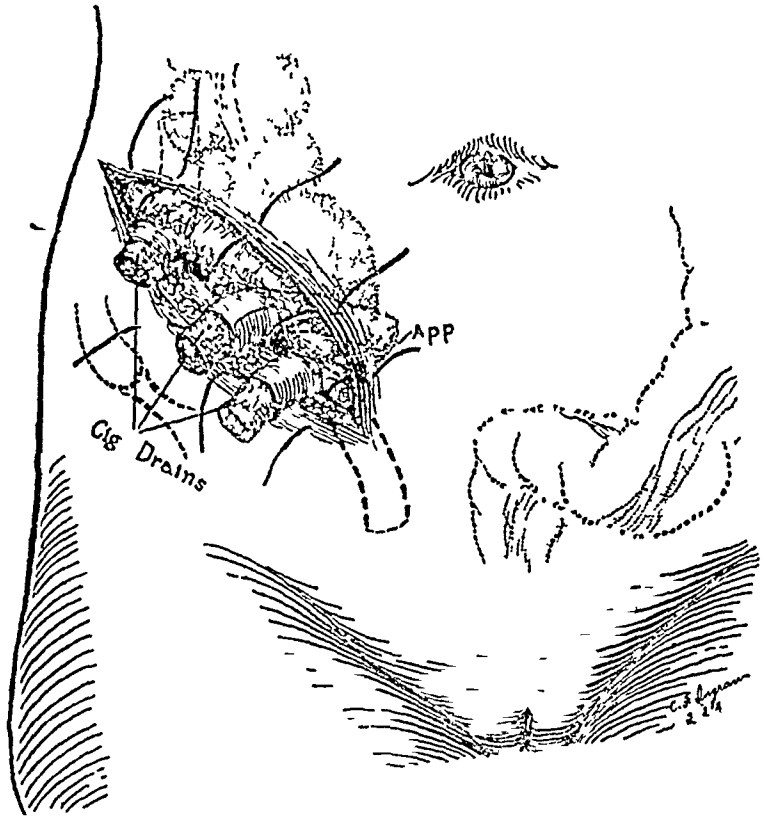


FIG 3 — Drainage employed in appendiceal abscess

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The total for the five years, 1910 to 1914, was 1385 cases with fifty-two deaths, a mortality of 3.7 per cent

In 1910, 275 cases, seven deaths, 2.5 per cent

In 1911, 257 cases, seven deaths, 2.7 per cent

In 1912, 297 cases, eleven deaths, 3.6 per cent

In 1913, 263 cases, fourteen deaths, 5.3 per cent

In 1914, 293 cases, thirteen deaths, 4.4 per cent

For the years 1915 to 1919, there were 1585 operations, with sixty-seven deaths, a mortality of 4.2 per cent

In 1915, 305 cases, thirteen deaths, 4.2 per cent

In 1916, 322 cases, twelve deaths, 3.7 per cent

In 1917, 340 cases, fifteen deaths, 4.4 per cent

In 1918, 285 cases, fifteen deaths, 5.2 per cent

In 1919, 334 cases, twelve deaths, 3.5 per cent.

Reviewing these cases it is seen that the mortality within the years 1901 to 1905 was rather high, being 10.5 per cent. In the next four years within which period the Fowler-Murphy-Ochsner treatment was instituted the mortality fell to 5.6 per cent, and finally, beginning with 1910, when all cases of spreading peritonitis were treated by the expectant method, the mortality fell to 3.7 and 4.2 per cent respectively for each five-year period. In the five-year period from 1915 to 1919 the epidemic of influenza no doubt accounts for the rather high mortality during the year 1918.

A careful study has been made of the cases of appendiceal abscess occurring during the years 1918 and 1919, because it was during these years that influenza affected the mortality.

In 1918 there were fifty-nine cases of appendiceal abscess. Eight (13.5 per cent) of the patients died. The ages of the patients were

Years	Number
1-10	0
11-20	18
21-30	25
31-40	8
41-50	5
51-60	2
61-70	0
71-80	1

The average length of hospitalization was from three to five weeks, the shortest time being two weeks and the longest fifteen weeks. The patients arrived at the hospital anywhere from one to twenty-eight days after the onset of the attack. The majority had been ill from two to six days before admission. Eight were operated on immediately. Thirty were operated on after one day on the Fowler-Ochsner treatment. Six were kept on this treatment for two days, four for three days, and one each for four, five and nine days.

A single purgative had been given in thirty-nine cases, multiple purgatives were given in four, while in sixteen no purgative was mentioned. A mass was definitely palpable in twenty-eight cases; there was a questionable mass in nine, and no mass in twenty-two. The incision employed was extraperitoneal in forty-eight, a large McBurney in five and a lower right rectus in six. The location of the abscess was said to be: Around the cæcum and terminal ileum in eight, in the pelvis in thirteen, and around the cæcum in thirty-four, in the omentum in one, behind the terminal ileum in two, retrocæcal in twelve, subcæcal in one, subhepatic in two, and subdiaphragmatic in five.

In several cases there were multiple abscesses in the pelvis, around the cæcum, or in the subdiaphragmatic area. The complications following operation were:

Obstruction of the ileum two cases, wound abscess, two cases, fecal fistula five, right-sided empyema two, secondary abscess two cases, hernia in one instance.

In one case there was an opening into the cæcum at the time of operation which was repaired, followed by an uneventful recovery.

Of the eight patients who died, all were under thirty-six years of age, and only one had not received a purgative during the illness. One patient had subhepatic and subdiaphragmatic abscesses with multiple abscesses in the coils of small intestine, and an abscess in the pelvis. A secondary operation was performed twenty-three days after the primary one and multiple secondary abscesses were found. Post-operative parotitis developed followed by death. This patient also had a cough with expectoration before the primary operation. Another of this group had a retrocæcal abscess, and later developed miliary tuberculosis with bacilli in the sputum, followed by death.

In one instance, retrocæcal, subhepatic and subdiaphragmatic abscesses were found at operation. Twenty-one days later a second operation was performed for multiple obstruction of the small bowel, and an abscess was found beneath the spleen. Death resulted two days later.

In another there was an abscess around the cæcum. Following operation a fecal fistula developed with secondary subdiaphragmatic abscess. This was drained. Two weeks later a right-sided empyema developed, and a rib resection was performed. Death occurred on the same day.

Case E. A. At the primary operation the peritonitis was not well localized. A fecal fistula resulted and was repaired four weeks later. In about ten days a right-sided empyema occurred. A rib resection was performed, and death occurred in seven days.

The other three deaths occurred from toxæmia following the primary operation. All of the fatal cases had been kept on "regulation" treatment for from one to nine days before operation.

In 1919 there were eighty-six cases of appendiceal abscess, nine (10.4 per cent.) of the patients died, one died without operation.

The ages of the patients were:

DEAVER AND MAGOUN

Years	Number
1-10	0
11-20	22
21-30	29
31-40	15
41-50	13
51-60	4
61-70	2

The average length of hospitalization was three to five weeks, the shortest time was one week and the longest eleven weeks. The patients were sick from one to twenty-one days before coming to the hospital. Twenty-six were operated on immediately on admission, thirty after remaining in the hospital on the Fowler-Ochsner treatment for one day, sixteen for two days, four for four days, four for three days, two for six days; and one each for five, seven and eight days. A purgative had been given (before admission) to sixty-five of these patients, multiple purgatives to seven, no purgatives to nine, no purgative was mentioned in four instances.

A mass was definitely palpable in thirty-nine cases, and was said to be in the right iliac fossa in fourteen. No mass was present in thirty-one cases, while in fifteen this item was not indicated in the history. The extraperitoneal approach was used in thirty-one cases, an enlarged McBurney incision in twenty-seven, a low right rectus incision in twenty-seven, and a high right rectus in one. The abscess was located as follows:

Retrocæcal in nineteen cases, around the cæcum forty-two, in the pelvis, nine, between the ileum and its mesentery in six, subdiaphragmatic five, subhepatic four, outer side of cæcum two, between the ascending colon and the ileum one. The complications following operation were:

1 Fecal fistula. In this case the cæcum had almost ulcerated through at the time of operation. The fecal fistula was repaired and an ileocolostomy performed. Recovery.

2 Fecal fistula repaired and ileocolostomy performed. Recovery.

3 Fecal fistula and obstruction of bowel. Resection of the cæcum and ascending colon, ileocolostomy. Recovery.

4 Fecal fistula, closed spontaneously. This patient developed incisional hernia, following the extraperitoneal approach type of incision. Repair of hernia, recovery.

5 Fecal fistula resection of cæcum and ileum, and ileocolostomy performed. Recovery.

6 Fecal fistula repaired. Recovery.

7 Fecal fistulas in three cases, closed spontaneously. Recovery.

8 Parotitis in two cases. Recovery.

9 Lobar pneumonia. Recovery.

10 Streptococci pneumonia. Death.

11 Pulmonary oedema. Death.

12 Diarrhoea and hemorrhage from bowel. Death.

13 Abscess of scrotum, incision and drainage. Death.

In one of the nine patients who died, the abscess was not located at the first operation and a secondary operation was not performed. Of the eight other cases, seven had been purged before operation. The extraperitoneal type of incision was employed in four, the enlarged McBurney in three, and a right rectus in one. In four of the cases death resulted from toxæmia following operation. One was associated with a subdiaphragmatic abscess and three with pneumonia.

SUMMARY

Acute appendicitis is, in the majority of instances, a disease of early adult life, although it may occur at any age.

In neglected cases the patients will remain in the hospital from three to five weeks after operation.

A purgative should never be given to patients with acute abdominal pain, until inflammation of the appendix is excluded.

The mortality in this disease has decreased practically 50 per cent during the last decade, and while the general increase in knowledge concerning it may partially account for this it would seem as if the expectant treatment of spreading peritonitis, as described, is also of value.

After the peritonitis has localized and a mass is present, the incision as described will be of value in the extraperitoneal approach to the ileum. In practically every case the appendix can be removed. Drainage varies with the situation of the abscess. Cigarette drains and pieces of gauze are commonly used, and occasionally as in pelvic abscess, a glass tube is used.

The highest mortality follows subdiaphragmatic abscess or multiple abscesses.

If the cæcum or ileum is indurated or ulcerated at the primary operation, fecal fistula will occasionally occur.

When the appendix, with the abscess lies under the terminal ileum, obstruction may follow.

In conclusion, it should be emphasized that prompt diagnosis and appendectomy will do away with many of these serious post-operative complications.

A REPORT ON 262 CONSECUTIVE CASES OF APPENDICITIS*

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THERE seems to be an opinion widespread among physicians that the problems connected with the medical and surgical treatment of appendicitis are solved That this complacent attitude is not justifiable is shown by the most superficial study of the mortality statistics of the Bureau of Census, and of the results of operations published by various clinics The number of deaths from appendicitis reaches an appalling figure

During the year 1917 there were 9374 deaths from appendicitis in the registration area of the United States In 1919 there were over 10,000 deaths, and in 1920 a few more than 11,000 deaths These deaths were distributed in age groups as follows

Age	Number of deaths
All ages	11,260
Under 5 years	425
5 to 14 years	2,130
15 to 44 years	5,906
45 to 64 years	2,229
65 years and over	570

There are no statistics on the total number of cases of appendicitis in the registration area, but a fair average figure for the mortality in all cases of appendicitis as given by most authorities is ten per cent Therefore, with ten thousand deaths we may safely assume at least 100,000 cases in the registration area for 1920 The above data show clearly that the general population is not receiving the full benefit of our present scientific knowledge of appendicitis

Considering the mortality rate for appendicitis reported by various clinics, we are struck by the great range of figures Thus some surgeons report as low a death rate as two per cent, and others as high a rate as 15 per cent It is improbable that this wide variation can be accounted for by the differences in virulence of the disease in different communities More likely it is due

- (1) To what the individual surgeon regards as acute appendicitis
 - (2) To the time in the disease at which operation is performed
 - (3) To differences in the medical and surgical management of the disease
- It is obviously of little value to strike an average of the widely varying

* From the Department of Surgery, Indiana University School of Medicine Read before the Tri-State District Medical Society, Des Moines, Iowa, October, 1923

mortality statistics. Furthermore, an especially low mortality rate does not necessarily imply better surgical treatment, nor does an especially high mortality figure condemn the work of the clinic reporting it. In the series here reported, in order that there may be no question of the nature of the disease, we have included only cases in which there was unmistakable, grossly recognizable gangrene or impending gangrene of the appendix. The report therefore represents the results obtained in the surgical treatment of the most advanced and dangerous cases. It has been our practice to employ drainage wherever there was manifest infection of the peri-appendiceal structures. Cases in which such infection had not occurred, in other words, in which there was contamination but not infection of the peritoneum, were closed without drainage. Of the 262 cases, 205, or 78.21 per cent, were pus cases. A five-day interval between onset of symptoms and admission had occurred in 144 of the 205 suppurative cases. A two-week interval had elapsed in 17 cases. Three had been sick twenty-one days, one twenty-eight days, and still another thirty-five days. Of the 205 pus cases only thirty-nine had been brought to the hospital sooner than five days after the onset of symptoms. The majority of them had been severely purged before admission. Most of the patients came from rural communities within a radius of 100 miles of Indianapolis. Only 10 per cent came from its immediate neighborhood.

This fact has a bearing on the time interval between the onset and date of admission. The family physician is commonly held responsible for delay of operation for appendicitis, but in our series he is not altogether to blame. A surprisingly large number of patients had not been seen by a doctor until just before admission. Very few of the patients came to the hospital without the correct diagnosis.

The death rate in our series was 8.7 per cent, if we include four patients who died immediately after admission and without operation, and 7.2 per cent if these cases are excluded. The death rate for the 205 suppurative cases was 9.2 per cent. In the 53 cases not drained, there were no deaths. The following table gives the age incidence of the disease in our series.

Age	Males	Females	Both sexes
0 to 5 years	1	2	3
5 to 10 years	14	13	27
10 to 20 years	62	39	101
20 to 30 years	33	14	47
30 to 40 years	25	13	38
40 to 50 years	15	6	21
50 to 55 years	5	0	5
55 to 60 years	3	0	3
60 to 65 years	3	2	5
65 to 70 years	2	0	2
70 to 75 years	1	0	1
Age not given	4	5	9
Totals	168	94	262

The accompanying curve (Fig 1) gives a graphic representation of the age distribution stated above

The deaths were distributed as follows

Age	Males	Females	Both sexes
0 to 5 years	0	0	0
5 to 10 years	2	1	3
10 to 20 years	3	0	3
20 to 30 years	4	0	4
30 to 40 years	3	2	5
40 to 50 years	1	0	1
50 to 55 years	1	0	1
55 to 60 years	1	0	1
60 to 65 years	2	0	2
65 to 70 years	2	0	2
70 to 75 years	1	0	1
Totals	20	3	23

The foregoing tables show that the greatest incidence of appendicitis is between the ages of ten and thirty years, and also that the greatest total number of deaths occurs between these years. The death rate, however, is lowest in this period.

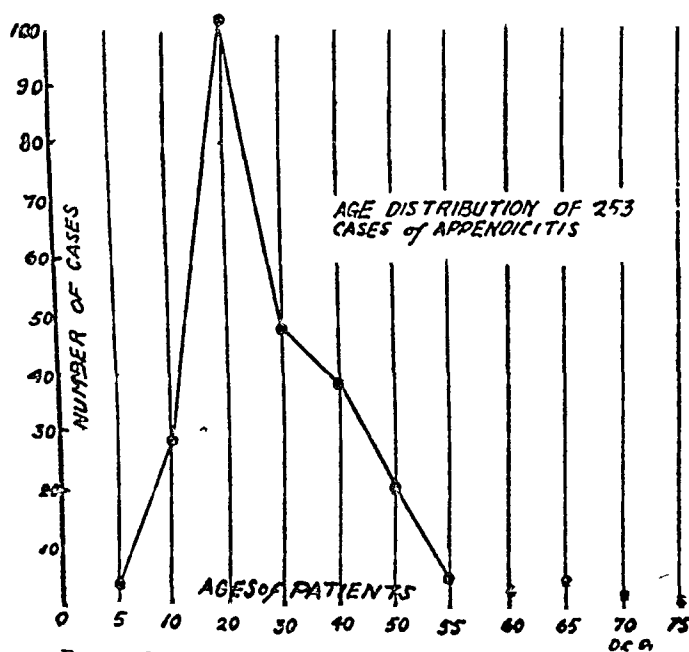


FIG 1—This table does not include the patients listed above as "age not given"

course. In many of them, however, gangrene was already present. Since the advantages of prompt diagnosis and early operation are universally admitted, it is needless to emphasize this point further.

The chief interest of this paper is in the group of two hundred and five advanced cases. That we are able to report such a series shows that the surgical management of these cases is still an important problem. We shall state first the surgical methods employed. Every patient was operated upon shortly after admission. As a pre-operative measure we used intravenous

injections of normal saline solution (800 c.c. to 1000 c.c.) for adults, whenever the patient was in poor condition. This in every case produced a marked improvement of the general condition. Dehydration is the chief cause of the marked circulatory failure which many of these patients have. It is brought about by vomiting, purging, and fever. The administration of the normal saline produces a most striking improvement in the pulse rate and blood-pressure and makes the operation comparatively safe. Light ether anæsthesia was used in all cases. Two hundred and twenty-nine cases were operated upon through a McBurney incision and 31 through a right rectus or midline incision.

With increasing experience we have used the McBurney incision almost to the exclusion of all others. Our results have shown its striking advantages. Thus, of the 11 cases who died of peritonitis, 7 were operated upon by the McBurney route and 4 by right rectus or midline incision. Of the 7 operated through the McBurney incision five had general

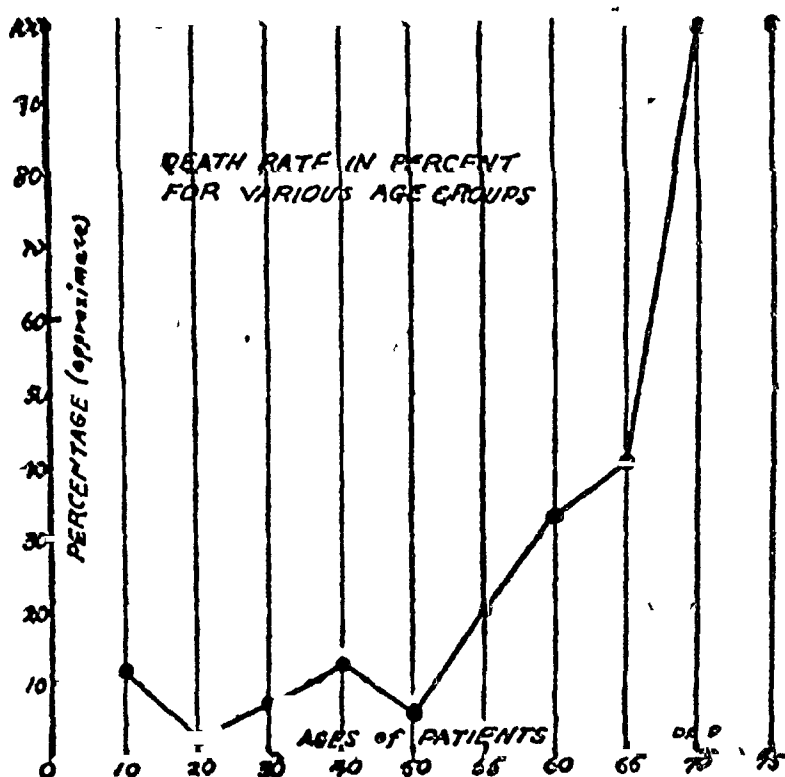


FIG 2 —Table representing death rate for various age groups

peritonitis at the time of operation and two did not. Thus in only two cases out of the 229 operated upon through the McBurney incision could death possibly be attributed to dissemination of infection at the time of operation.

Moreover, among the patients who recovered, the McBurney cases had far less trouble than those operated upon through other incisions, and the period of convalescence was greatly shortened. The average stay in the hospital after operation of the McBurney cases was twelve days, of the right rectus and midline cases fifteen days. These figures are for the group as a whole.

Another bit of operative technic which we regard as important, is the avoidance of the use of gauze packs to wall off the region of the abscess. These traumatize the peritoneal surfaces and actually lead to a much wider infection of the peritoneum than would occur if they were not used. When the abscess is open, the conditions of intra-abdominal pressure are such that the pus is forced toward the incision and despite appearances, much less infection of the peritoneum is produced than occurs when the pus is rubbed into the surface by the gauze.

We removed the appendix in all cases. We appreciate that this is contrary to the advice of many surgeons, and recognize that when such removal entails prolonged search and extensive trauma it should not be done. However, when the appendix is readily found and this is the case in the vast majority of cases—its removal can be quickly and safely accomplished without any added risk.

Removal of the appendix in the presence of abscess or peritonitis has been discredited because by the ordinary technic of freeing an adherent appendix completely, much time is consumed, troublesome hemorrhage is apt to occur, and the inflamed bowel may even be opened. If, however, what we may call the "submuscular technic" is employed, no matter how badly adherent the organ may be and no matter what its location, provided any part of it, base or tip, can be found, it can be removed in a few moments. The method consists in incising the serous and muscular coats of any portion of the appendix which can be found and of pulling out the tubular submucous coat through the incision so made. Once this is accomplished, the submucous coat and the mucosa through the entire length of the appendix can be pulled out, much the same as an angeworm can be pulled out of its hole. It is unnecessary to tie a single vessel. The base of the appendix is recognized by the increase in size of the submucous tube as the latter is pulled out.

For drainage material, we used entirely sheets of rubber. Whenever the cæcum was thickened and semi-gangrenous so that the danger of fecal fistula seemed imminent, we placed these rubber drains so as to form a complete cofferdam about the dangerous area. One central drain was usually employed, which was removed in twelve hours, thus making room for the escape of any pent-up exudate. Drainage of course was employed solely for the purpose of forming a tract for the discharge of the infected material from the walls of the abscess. Gauze, glass, or rubber tubes were never used.

The essentials of the post-operative treatment may be summarized as follows: (1) The administration of an adequate amount of fluid. (2) Morphia. (3) Starvation until peritonitis had subsided. (4) No cathartics. (5) Gastric lavage. (6) Frequent examination for pelvic and subphrenic abscesses.

We gave daily a quantity of fluid sufficient to keep the urine output for each twenty-four hours at 1000 c c or more. The water was given by mouth if well taken, otherwise by proctoclysis or by the intravenous route. For the very ill or moderately ill patients we prefer the latter method to all others. We have repeatedly administered as much as 1400 c c of normal saline at a time. Many of the patients with widespread peritonitis were given intravenously a litre of normal saline three times a day for five to seven days. The method entails less disturbance of the patient than any other method of administering fluid. In hundreds of administrations, we have yet to see a serious result. Certainly no such quantities of fluid can be administered by hypodermoclysis without producing a most distressing soreness of the patient's entire body. We employed proctoclysis whenever it could be carried out with-

out distressing the patient unduly. We feel that the administration of an adequate amount of fluid is the single most important part of the treatment. The circulatory failure in a great majority of instances is due to dehydration. The heart is a perfectly competent pump, but the circulation fails through lack of sufficient fluid to be kept moving.

The second important element of the treatment was the administration of morphine in quantities sufficient to keep the patient at rest mentally and physically. Morphine in our experience does not increase abdominal distention or diminish the excretion of urine. Nothing more rapidly exhausts the vital reserve of a patient than pain and worry.

The third important part of the treatment was starvation. It is best to withhold nourishment as long as there is any noteworthy distention or nausea. In a severe case of peritonitis this may mean starvation for a week to ten days. It is idle and harmful to attempt to feed a patient with paralytic ileus. Such prolonged starvation may produce an acidosis. Of late we have combated this by the administration intravenously of 2 per cent glucose solution, combined with small doses—1 to 3 units of insulin.

We cannot overstate the importance of gastric lavage in the post-operative treatment of peritonitis. Unrecognized distention of the stomach may prove fatal in a few hours. In case of doubt always pass the stomach tube. It is necessary at times to pass it as often as every two hours.

The patients were watched carefully for the development of subphrenic or pelvic abscesses and these were drained in all cases as soon as discovered. A pelvic abscess should be suspected in every case of gangrenous appendicitis, and a rectal examination made as a routine both before operation and at intervals after operation not more than two days, as long as fever is present.

We have used the Fowler position in practically all cases. We are inclined to attribute the apparently beneficial effects of the sitting posture not to its supposed tendency to limit peritonitis to the lower part of the abdomen so much as to its beneficial action on the breathing and on the circulation. In fact, we have often seen patients who could not endure the recumbent posture, but who were entirely comfortable when allowed to sit upright. The sitting posture is absolutely life saving for very fleshy patients.

It is instructive to study the causes of death of the nineteen cases who died after operation. The following table gives this in brief form.

Peritonitis	11
Myocardial failure	1
Intestinal obstruction	2
Multiple liver abscesses	1
Pulmonary complications	2
Subphrenic abscess	1
Uræmia (man of 65)	1
	—
	19

Let us consider first the cases who died of peritonitis. These may be divided into three groups.

Group 1 There are five of the clinical histories which indicate early diagnosis and prompt treatment, but record a fatal result. This group includes one case not operated upon. In these cases we must assume that the infection is extremely virulent or that the patient's resistance is unusually low. These patients are sick only a short time and have a general septicæmia in addition to a general peritonitis. This can be proved by blood culture. The following is a typical case.

R. C., male, age twenty-eight, admitted with a complaint of severe abdominal pain. The patient had been unusually healthy, his only illnesses having been measles and pertussis in early childhood, and pneumonia at the age of fourteen. His present illness began twenty-four hours before admission with generalized abdominal pain, which shortly localized in the right iliac fossa, and vomiting. On admission the patient was in agonizing pain and appeared somewhat dehydrated. Temperature was 103, pulse 100, respiration 22. His leucocyte count was 13,000. The patient was operated upon immediately and an abscess containing a gangrenous appendix and about 30 c.c. of foul pus was found. When the peritoneum was opened, several ounces of curdy fluid poured through the McBurney incision. The appendix was removed and the wound closed in the usual way about several rubber dam drains. While in the operating room the patient was given an intravenous injection of 800 c.c. of normal salt solution. On return to the ward his pulse was 120, but six hours later it had risen to 160 while the temperature was 104. The leucocyte count had dropped to 8300. The patient died in fourteen hours in spite of another intravenous injection of normal saline and the general supportive treatment usually employed in such cases. Blood withdrawn an hour before death contained the *E. coli communis* in pure culture.

Group 2—The second group of fatal peritonitis cases is that in which purgation was employed before operation. All authorities emphasize the bad effects of cathartics in appendicitis. The violent purging if successfully obtained dehydrates the patient, weakens him, lowers his general resistance, and makes him a poor operative risk. The following case clearly illustrates the effects of such treatment.

H. C., girl, aged ten. The patient was sent to the hospital with the diagnosis of appendicitis. Her family and past personal history were negative with the exception of measles, chicken pox and mumps, which she had early in life. She was admitted to the hospital about seventy-two hours after the onset of her illness. She had been given several doses of castor oil, two compound cathartic pills, eight quarter grain calomel tablets, a dose of magnesium sulphate and several enemata. On admission she presented the typical picture of an advanced general peritonitis. The abdomen was rigid and immobile, and gave the physical signs of free fluid. The temperature was 102.8 F., pulse 165 and leucocyte count 16,000. The patient was operated upon immediately and died in about five hours.

Group 3—The third group of peritonitis cases is that in which the bowel is unduly manipulated at operation. Four of our patients who died of peritonitis may probably with justice be placed in this group. Two of these cases were among those operated upon through a right rectus or midline incision. With this type of incision it is practically impossible to prevent extensive soiling of the peritoneum when an appendiceal abscess is drained.

Using the McBurney incision it is possible to open directly into the abscess, or at least into the area of infected peritoneum, to drain off the pus, and to remove the appendix without danger of spreading the infection.

It will be noted that peritonitis accounts for more than one-half the deaths in our series. Eight deaths occurred from such miscellaneous complications as myocardial failure, intestinal obstruction, multiple liver abscesses, pneumonia, subphrenic abscess and inæmia. In one case of intestinal obstruction, at a second operation performed eight days after the first, almost the entire small intestine was found in the pelvis with the loops densely adherent to one another and to the structures of the pelvis. Enterostomy was unavailing. The subphrenic abscess numbered in this list was discovered at autopsy. It covered the posterior surface of the liver and was draining through the McBurney incision. The appendix in this case was retrocaecal in location.

General Discussion Perhaps no phase of the treatment of acute appendicitis has been more debated than the proper time for operation. Our experience as given in this report throws some light on this matter. We operated invariably on admission in every case except four who were obviously in a dying condition. We are willing to grant that in some instances, *e.g.*, the two cases reported above, that operation is absolutely useless, since we are dealing with patients who are already overwhelmed by a general peritonitis and a general septicæmia. However, a careful study of the clinical history in the fatal cases, with the exceptions noted above, fails to show that the operation in any case even hastened the inevitably fatal outcome. Since all but 35 of the 205 pus cases had been sick for five days or more, the results here reported are a fair index of the mortality rate in the late stage of the disease. Granting for the sake of argument that if operation had been performed earlier there might have been more deaths from peritonitis, some at least of the eight deaths from miscellaneous causes could almost certainly have been prevented by an earlier operation.

When we consider what is taking place about a gangrenous appendix, we can hardly believe that its removal except in the very terminal stages of the disease could be other than beneficial. The pus is accumulating in most cases behind a thin layer of peritoneal adhesions. Through this frail barrier the pus escapes here and there as the tension gets too great. This escape of pus leads to the constant throwing out of new adhesions until the abscess reaches a great size. The adhesions alone place the patient's life in danger of intestinal obstruction and he is further exposed to venous thrombosis, embolism, and to a general septicæmia.

With proper preparation, the operative technic described above can be carried out in a comparatively short time—15 to 20 minutes—and it is certainly not dangerous. In the entire series there was no death on the table or short of several hours after operation. The operation advised does not lead to the spread of peritonitis.

Finally, we wish to emphasize the importance of optimism and a fight-to-the-last-ditch spirit on the part of the surgeon. A healthy young patient will withstand a whole lot of peritonitis if he is given plenty of fluid, if his strength is conserved, and if complications such as pelvic and subphrenic abscesses, and gastric distention are promptly diagnosed and treated.

SUMMARY AND CONCLUSIONS

(1) Appendicitis is probably the most important and frequent surgical disease. About 14,000 people die annually from it in the United States.

(2) A series of 262 consecutive cases of gangrenous appendicitis is reported. The death rate for the entire series was 7.2 per cent, the same for 205 cases complicated by abscess was 9.2 per cent.

(3) The pre-operative intravenous injection of normal saline solution is advocated as a treatment for all very sick patients.

(4) The advantages of the McBurney incision are pointed out.

(5) The expectant treatment of appendicitis is not advised.

(6) Removal of the appendix by the technic described does not increase the risks of operation in most cases.

(7) The post-operative treatment employed consisted in .

(a) The administration of plenty of fluid, by the intravenous route, if water could not be taken by mouth.

(b) Sufficient morphine.

(c) Starvation until peritonitis had completely subsided.

(d) No cathartics.

(e) Free use of gastric lavage.

(f) Frequent examination for secondary abscesses, and prompt drainage of the same.

(8) Peritonitis accounted for 11 of the 19 deaths which occurred in the series. The chief causes of peritonitis were purgation and extreme virulence of the infection.

(9) Certain virulent and rapidly fatal cases of appendicitis are complicated by a general septicæmia.

(10) Prompt diagnosis and early operation in appendicitis would decrease the mortality almost to the vanishing point.

LYMPHOID HYPERPLASIA OF THE APPENDIX IN CHILDREN ITS RELATION TO RECURRENT APPENDICITIS

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THE purpose of this paper is to call attention to the frequency with which excessive lymphoid hyperplasia of the appendix in children produces symptoms simulating appendicitis, usually of the subacute or chronic recurrent type, and, also, at the same time to suggest the propriety of considering this condition a distinct clinical entity of sufficient importance to entitle it to a place as such among diseases of the appendix.

During a period of eight years, from January 1, 1916, to December 31, 1923, 340 children under twelve and one-half years of age were operated upon for acute appendicitis on the Children's Surgical Service at Bellevue Hospital, the records stating definitely that gross pathological lesions of acute inflammation were present in every case. During this same period, some fifty-five children were operated upon because of symptoms suggesting appendicitis, in which no gross pathological lesions of acute inflammation were found, and in this group the laboratory reports of forty-nine cases are available. Of these, five showed the presence of pinworms, three were reported as showing no noteworthy changes, two were reported as early exudative appendicitis, and two as early suppurative appendicitis. It is with the remaining cases of this group, thirty-seven in number, that this paper has to deal. Some of these were diagnosed as acute, the majority as subacute or chronic appendicitis, because the symptoms seemed less severe than the usual run of acute cases, recurring with more or less frequency, and were operated upon only to find what to all appearances was a normal appendix, with the exception of two, in which the position was retrocaecal. The only pathologic change visible, if pathologic it be, was the injection of the vessels of the peritoneal coat of the appendix and also some enlargement of the mesenteric lymph-nodes, particularly in the ileocolic angle, which was noted in some of the cases. Grossly the appendix itself was not rigid or thickened, it was free from adhesions, and there was no sign of a permanent kink or twist, nor were concretions present within the lumen. In a few appendices, there was slight clubbing at the tip.

These children were operated upon because of severe colicky pain, lasting for several hours to a day or more, and localizing itself in the right iliac region. This was associated with definite localized tenderness in nearly every case. The other symptoms of acute appendicitis, namely, spasm of the right rectus muscle, nausea and vomiting, fever and leucocytosis, were not constant. All of these appendices were sent to the laboratory and the pathological reports stated very definitely that no inflammatory changes were present, but that, in each and every one, there was a marked hyperplasia of the lymphoid tissue, with or without sclerosis of the interstitial tissues of the submucosa. In a

few of the older children who gave a history of many previous attacks, this sclerosis of the interstitial tissues predominated, and was associated with atrophy of the appendix

In other words, among the children operated upon with a diagnosis of appendicitis during a period of eight years, a little less than ten per cent showed no evidence of inflammatory change in the appendix whatsoever, but all of them did show definite and constant microscopic changes involving the lymphoid follicles with which this organ in the young is richly endowed

It must be remembered that a striking feature of the structure of the appendix is the quantity of lymphoid tissue in its walls. It has been compared to a Peyer's patch thrust out from the bowel like the finger of a glove, and is sometimes referred to as the abdominal tonsil. Numerous lymphoid follicles may be seen in serial sections of a normal appendix lying in the mucosa or even in the submucous layer. These resemble the solitary and agminated glands in other parts of the intestinal tract, but, in comparison with the size of the appendix, they are relatively much more numerous. It is said that an appendix three and one-half inches long contains from 150 to 200, or more, such follicles. This lymphoid tissue reaches its height of development in late childhood or adolescence, and, from then on, its tendency is to undergo involutional changes resulting in sclerosis and atrophy.

Six years ago, in a paper entitled "Lymphatic Disease in Children Simulating Appendicitis," Barss¹ reported from the hospital of the University of Michigan seven cases where appendices in children under fourteen years of age had been removed because of definite symptoms of appendiceal disturbance of a subacute nature. In none of these appendices did the microscope reveal any inflammatory changes, but in all there was a marked hyperplasia of the lymphoid tissue, the pathologist stating that the microscopic appearance of the lymphoid tissue in two of the removed appendices would suggest the possibility of lymphatism. These children were operated upon because of severe colicky pain and localized tenderness in the right iliac region. Each patient complained of nausea and most of them of vomiting, but in no case was there marked spasm of the right rectus muscle, and in none was fever present, nor was there a leucocytosis. Both headache and constipation occurred in nearly every case. In three cases it was observed that the mesenteric lymph-nodes were considerably enlarged.

In this paper, Barss called attention to the fact that the appendiceal symptoms were accompanied with changes in the lymphoid tissue of the appendix, these changes being similar to those which are regularly found in lymphoid tissue, wherever situated, in subjects of status lymphaticus.

Five years ago, Symmers and Greenberg,² reporting from the pathological

¹ Barss, Harold de B. Lymphatic Disease in Children Simulating Appendicitis. *Am J Dis Child*, vol xv, p 421 (June), 1918

² Symmers, Douglas, and Greenberg, Morris. The Clinical Significance of Lymphoid Hyperplasia of the Appendix. *Journ A M A*, Feb 15, 1919 vol lxxii, pp 468-470

laboratory of Bellevue Hospital, called attention to the great frequency with which appendices removed at operation on patients, especially under the age of thirty years, revealed no microscopic alterations other than lymphoid hyperplasia, with or without the association of moderate sclerotic changes in the connective tissue. They stated that in the pathological records at Bellevue Hospital, which include the results of the microscopic examination of several thousand appendices, the occurrence of excessive lymphoid hyperplasia was described as the sole, or the predominant change in about ten per cent of the total number. There was no sign of inflammatory exudation present, and yet all of the patients had been subjected to operation because of definite symptoms of appendiceal disturbance. In analyzing twenty of the clinical histories of cases whose appendices showed this condition, they found that these patients complained of attacks recurring at intervals of weeks or months, characterized by cramp-like pains or by pain and moderate tenderness in the right iliac region lasting for several hours or days. Muscular rigidity was either very slight or not present. Nausea was common but vomiting rarely occurred. The temperature was normal in every instance, and the pulse rarely exceeded eighty or ninety beats to the minute. Headache and constipation were fairly common. The average age of these twenty cases was seventeen and one-half years. In every case operation was followed by recovery.

They described these appendices as presenting no gross or microscopic changes indicative of inflammation. Some appeared slightly enlarged, the majority were normal in size. There was some congestion of the vessels of the serosa. The lumen was diminished in size or even occluded. The mucosa was thickened and swollen. Microscopically these appendices showed hyperplasia of the lymphoid follicles attended with degenerative or necrotic lesions in the germinal areas, with or without sclerosis of the interstitial tissues of the submucosa. They described also an appendix occurring oftenest in older patients which was diminished in size, sometimes reduced to a cord-like structure, which, on microscopic examination, showed almost complete connective-tissue replacement of the mucosa and obliteration of its lumen. These authors believe that the degenerative changes found in the lymphoid tissue of these appendices is best explained as a histological evidence of status lymphaticus. At the same time they pointed out that there is a clinically recognizable syndrome referable to lymphoid hyperplasia of the appendix.

Of the thirty-seven cases which form the basis of this report, twenty-two were girls and fifteen were boys, which is interesting in that it shows a sex incidence quite the reverse of that which occurs in acute appendicitis in children, in which year after year our records have shown a preponderance of males over females, almost in the ratio of two to one. Because of the age limit of this service, not one of our children was more than twelve and one-half years old, but it is significant that twenty-two, or sixty per cent, had passed their tenth birthday, which would lead one to suspect that the condition becomes more frequent as adolescence is approached. Our youngest patient was a child five and one-half years old.

All gave a history of colicky pain, more or less severe, and often intermittent, usually starting about the umbilicus, and later localizing in the right iliac region. Many of the histories lay especial stress on the severity of this pain, describing it as sharp, stabbing, knife-like, or cramp-like, the patients often being doubled up because of its intensity. This appendicular colic, for that is what it really is, lasts for periods varying from fifteen or twenty minutes to several hours or more. The increase and swelling of the lymphoid elements, together with the inelasticity of the peritoneal sheath of the appendix, as pointed out by Morris some years ago, is the most likely explanation of this pain. These colicky attacks are often described as intermittent, occurring several times every day, or once or twice every twenty-four hours for a period of days, during the periods of remission the child appearing quite well, and even going out into the street to resume its play. Thirty children gave a history of repeated attacks occurring at varying intervals and dating backward over a period of weeks, months, or years. A history of severe, colicky pain, localizing in the right iliac region, recurring from time to time, is probably the most characteristic feature of lymphoid hyperplasia of the appendix, and suggesting, as it does, what is generally known as recurrent appendicitis, it is a fact of considerable significance that of our 340 children with definite acute appendicitis, not over three per cent gave a history of previous attacks.

Twenty-four vomited with the present attack. This vomiting was generally repeated one or more times, and in several it preceded the colicky pain by several hours. Nausea as a symptom, independent of vomiting, was recorded but once.

There was some degree of tenderness or sensitiveness in every one of these patients. In six, it was recorded as marked, and in the remainder as moderate or slight. Rigidity, on the other hand, was recorded as marked in but three children; nineteen had no rigidity whatsoever, and of the remaining fifteen, muscular spasm was said to be either slight or very moderate.

In the articles concerning lymphoid hyperplasia of the appendix, both of Baiss, and of Symmeis and Greenberg, already mentioned, it is stated that fever was absent in every case, and that there was very little, if any, increase in the white cell count. This has not been true in our cases, for a rectal temperature of more than 100° was present on admission to the hospital in fourteen children, the highest temperature being 102.6° in a girl twelve years old. These temperatures rapidly subsided as soon as the children were put to bed, and were probably due to causes outside of the appendix.

The white cell count was recorded in twenty-nine cases. One child, a girl of eleven, had a leucocytosis of 15,000. Six children had a leucocytosis between 12,000 and 14,000. For years past we have adopted for our own use the more or less arbitrary standard that in children all counts below 12,000 are normal, and that counts between 12,000 and 14,000 represent a moderate leucocytosis and are of no especial significance. The average leucocyte count in these twenty-nine cases was 10,700.

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Constipation was the rule but two children suffered from diarrhoea during the attacks. Headache was mentioned as a prominent symptom in five cases. Some degree of enlargement of the cervical lymphatic glands was present in the majority of these children. General superficial lymphatic adenopathy was recorded in but one case. The mesenteric lymph-nodes are recorded as enlarged in five cases. The glands in the ileocolic angle are the ones usually seen, and therefore mentioned, but in one it was demonstrated that the lymph-glands of the entire mesentery were enlarged. In one child, the glands could be palpated through the abdominal wall and were mistaken for a localized appendicular abscess. The microscopic examination of these lymph-nodes showed simple hyperplasia. Hypertrophy of the tonsils was noted in sixteen of the children and in six others the tonsils had been removed at some time prior to their coming to the hospital. In no case was the spleen enlarged, and there was no record as to the condition of the thymus gland.

I have gone into the symptoms at some length, and at the risk of being considered unnecessarily prolix, but in so doing, I have tried to show just how these cases differed in their symptomatology from those of acute inflammation of the appendix and whether clinically they could be so distinguished.

The following brief extracts from the histories of some of these patients, which have been selected without regard to any particular point except that they have been followed up for a period of six months or more following operation, show better than anything else the clinical picture presented by these children.

CASE I—Female, six and one-half years old admitted March, 1917. One year before child was in the hospital because of severe pain in right iliac region accompanied by vomiting. She was kept in the hospital for two weeks under observation, and then allowed to go home. For the past six weeks child has had pain which comes on almost daily. She cries when she has this pain, rubs her hand over the lower right side of her abdomen. She has not vomited during this attack. She is constipated. Her appetite is good, and she has not been confined to her bed. Temperature on admission 100.3° , pulse 100. Leucocytes 13,400, polymorphonuclears 54 per cent. Urine negative. Examination shows that there is no muscular rigidity and but slight tenderness over McBurney's point. Provisional diagnosis—chronic appendicitis. Pathological report No 2857. Marked lymphoid hyperplasia. No return of abdominal symptoms at the end of fifteen months.

CASE II—Male, age eleven, admitted March 30 1917. This boy has had abdominal pain off and on for the past three months. This pain is sharp and colicky, and is located just to the right of the umbilicus. He has not vomited and he is not constipated. His temperature is 98° , pulse 72. Leucocytes 14,400, polymorphonuclears 76 per cent. Urine negative. There is some tenderness on pressure over the right iliac region, but muscular rigidity is not present. Provisional diagnosis chronic appendicitis. Pathological report No 2977. Lymphoid hyperplasia of the appendix. No return of symptoms after six months.

CASE III—Female, age twelve, admitted January, 1920. For a number of years has had attacks of general pain in abdomen associated with nausea, vomiting and headache, occurring every two or three weeks. For the past year she has been having attacks of pain in abdomen in the region of the umbilicus. Sometimes she is nauseated, and sometimes she vomits. Frequently she belches gas. Present attack began twenty-four hours ago. She was seen by a doctor at her home, who made a diagnosis of acute appendicitis. On admission, it was noted that the child looked acutely ill, her tempera-

ture being 102.6° , her pulse 126 There is no record of the blood count Physical signs negative, except slight rigidity over lower right quadrant of the abdomen, with considerable tenderness on pressure Provisional diagnosis—acute exacerbation of a chronic appendicitis Pathological report No 53 Lymphoid hyperplasia of the appendix with sclerosis No return of symptoms at the end of eight months

CASE IV—Male, age eleven, admitted February 17, 1920 Two weeks ago this boy had a sudden pain in the right side which doubled him up This attack lasted two days On the third day he got out of bed, but still had slight pain in his right side which has been continuous Once or twice a day he gets an attack of cramps, which causes him to go to bed while it lasts These attacks come on every day His bowels are constipated On admission, his temperature was 98° Leucocytes 9400 Provisional diagnosis—subacute appendicitis Pathological report No 13181 Lymphoid hyperplasia with slight sclerosis No return of symptoms at the end of eight months

CASE V—Male, age eleven, admitted April, 1920 For the past four years has had recurrent attacks of pain and soreness in right lower quadrant These attacks last one or two days They are not accompanied by vomiting The patient is obstinately constipated Present attack began six days ago There is pain in right lower quadrant with very slight rigidity and tenderness on deep pressure Leucocytes are 9800 Temperature on admission 99° , pulse 84 Provisional diagnosis—chronic appendicitis Pathological report No 3325 Lymphoid hyperplasia of the appendix No return of symptoms at the end of ten months

CASE VI—Male, age nine, admitted August 1920 Severe abdominal pain, intermittent in character for past three days, with vomiting, fever, and headaches He is constipated There is little or no rigidity, and tenderness only on deep pressure Temperature 102.2° Leucocytes 10800 Pathological report No 6329 Marked lymphoid hyperplasia of appendix, with sclerosis No return of symptoms at the end of two years

CASE VII—Female, age ten, admitted October, 1922 About one and one-half years ago had first attack, sudden in onset, of very severe, cramp-like pain in right side, which doubled her up This lasted about ten minutes She did not vomit About one week later had another similar attack During the next six months had about one attack every week For the past year has had about one attack a month Recent attacks have been accompanied by vomiting She is not constipated and there are no urinary symptoms She was referred to the hospital with a diagnosis of chronic appendicitis Her temperature on admission was 100.4° , her pulse 108 No blood count was recorded Physical examination was negative with the exception of slight tenderness on pressure at McBurney's point, with no muscular rigidity At operation the vessels of the appendix were found slightly injected, and the mesenteric lymph-nodes enlarged Pathological report No 11,583 Lymphoid hyperplasia of the appendix Hyperplasia of mesenteric lymph-nodes No return of symptoms at the end of eight months

CASE VIII—Female, age twelve admitted December, 1922 Present illness has lasted off and on for about one year, with attacks of pain localizing in the right lower quadrant This pain is sharp, knife-like in character, and more or less constant It is more severe in the morning, with a few hours of relief during the day There is no rigidity and tenderness can be elicited only on deep pressure Provisional diagnosis chronic appendicitis Pathological report No 14087 Lymphoid hyperplasia of appendix No return of symptoms at the end of fourteen months

It may be said that the majority of these children presented a very typical picture, recognized by repeated attacks of appendicular colic attended with moderate local tenderness and little or no muscular rigidity, occurring at intervals of days weeks or months It was often associated with obstinate constipation, and with nausea and vomiting also with headache but is not as a rule accompanied by noteworthy changes in temperature or blood count

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In that small number of cases where muscular rigidity, temperature, and leucocytosis are sufficient to suggest an underlying inflammation, some difficulty may be experienced in distinguishing between this and an acute appendicitis, nor do I see that any useful purpose is being served in making any distinction under such circumstances, for, after all, the treatment of both conditions is the same.

All of these children were improved by operation. Ether was administered in every instance, and there is no record of any difficulty in connection with the anæsthetic. In every case, the post-operative recovery was prompt and without complication, with the exception of two in whom a post-operative bronchopneumonia delayed convalescence for a few days.

Following operation, thirty-one children were followed up for periods varying from three months to six years. Two of these continued to have occasional attacks of cramps following indiscretions in diet, but the remainder were quite free from abdominal symptoms. In fact, one of the most striking features of this condition was the way children who had been having attacks every few weeks for months, and even years, were completely and permanently relieved of their symptoms following removal of the appendix.

The question naturally arises as to the nature of this condition. With the exception of the two articles already quoted, there has been very little in recent literature concerning the clinical significance of lymphoid hyperplasia of the appendix. Eight years ago, Eli Moschcowitz,³ in an article on the "Pathology of Appendicitis," stated that lymphoid hyperplasia of the appendix was rare, and, in his opinion, usually associated with a status lymphaticus. He mentions the fact that some authors have described it as pseudo appendicitis lymphatica. Among pathologists, more and more are taking the view that it is a condition peculiar to subjects of lymphatism. This latter belief is based on the fact that the degenerative lesions found in the germinal areas of the hyperplastic lymphoid follicles of the appendix are characteristic of lymphoid tissue wherever found in subjects of status lymphaticus, and it may be that this type of appendix is best explained as a local manifestation of this condition, remembering always that the modern conception of status lymphaticus connotes a type presenting certain stigmata and physical attributes possessed by a great number of individuals, some of whom are particularly susceptible to certain infections, and some few succumb even to the most trivial of injuries, but, on the other hand, there are many of these subjects, perhaps the majority, who are able to withstand not only various degrees of trauma, but infections as well.

While in our experience the symptom complex which these children present is completely and permanently removed without untoward result by operation, if it be a condition peculiar to subjects of status lymphaticus, the question may properly be raised whether or not those children who show marked and unmistakable evidences of the stigmata of this condition should be operated

³ Moschcowitz, Eli. Pathology of Appendicitis. ANNALS OF SURGERY, vol. LXIII, p. 709, No. 6, June, 1916.

upon as a matter of routine, owing to the possible danger of sudden or unexpected death. This is a question each one must settle for himself, but it may be said with great positiveness that if there be in a given case any doubt as to whether the symptoms are those of acute appendicitis or those of lymphoid hyperplasia, the indication to operate is plain, for it may be accepted as a truism that the actual danger of an unoperated acute appendicitis is far more real than is the potential danger of a status lymphaticus.

In conclusion, it may be said that so-called subacute or chronic appendicitis, usually of the recurrent type, occurs in approximately ten per cent of children with appendiceal symptoms. In the great majority of these cases the symptoms are due not to an inflammation of the appendix, but to excessive hyperplasia of the lymphoid tissue in its walls, which symptoms are promptly and permanently relieved by removal of the appendix. Furthermore, as the majority of these cases conform to a recognizable syndrome, lymphoid hyperplasia should be considered as a clinical entity among diseases of the appendix.

TUMOR OF THE OVARY WITH TWISTED PEDICLE, OCCURRING IN A CHILD TWO AND A HALF YEARS OF AGE

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ATTENTION has been called a number of times in the literature of ovarian tumors in children to the report of Wiel, 1905,¹ showing 62 ovarian tumors in children under the age of ten, and 24 under the age of five years. This covered a most extensive study of statistics and was the outgrowth of interest developed in a

patient five years of age operated on by Dr. Howard Kelly. Since this time, subsequent single case reports have been made and it is pointed out by Downes² that a careful pathological analysis of the tumors showed that 62 per cent are classified as malignant as against a 32 per

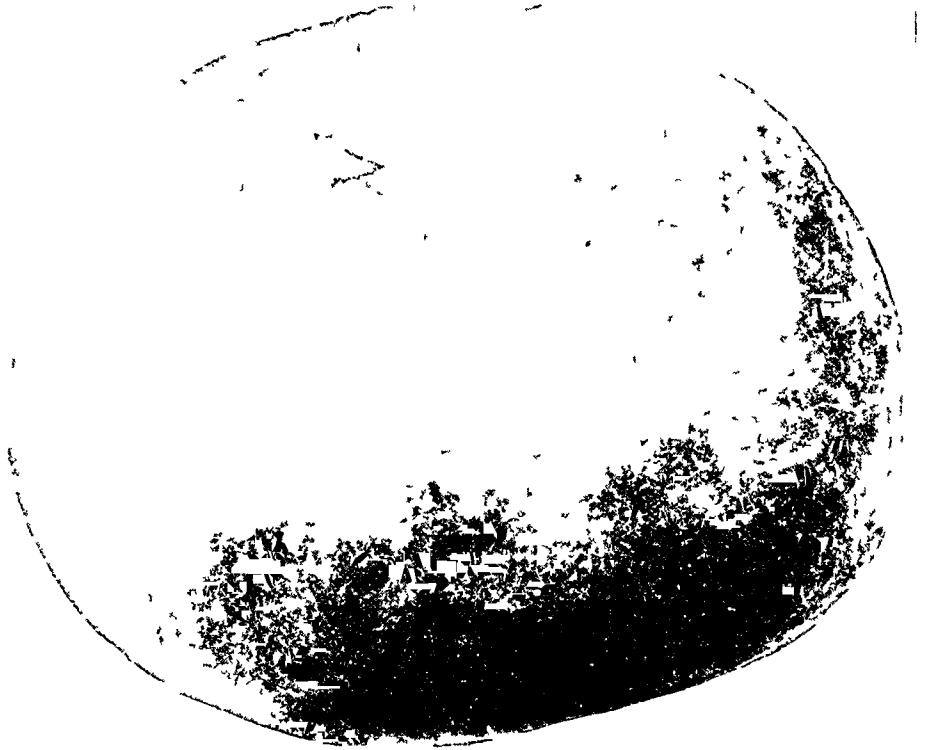


FIG. 1.—Gross specimen. Shows a comparatively smooth surface with darker mottled areas representing the hemorrhage into the wall.

cent in the series of Wiel. Downes explains this discrepancy upon the basis that probably a more careful microscopical examination of the multiple sections had been made in the later series. Nothing further has been contributed than that a great many so-called simple cysts have been found upon careful examination to be dermoids. The most recent report is by Dr. Von W. Mittelstaedt,³ in which he merely records an ovarian tumor but does not specify the pathology or bring out any new discussion. An early case was reported in 1886 by Carmaby and Howard, of a child, twelve years of age, which was very similar to the one now being reported. The outstanding features being acute abdominal pain and toxæmia, simulating appendicitis.

The particular interest in the case I have to report is from a clinical standpoint. Three years previous to the operation an uncle of the patient had an acute attack of appendicitis, the appendix ruptured and was subsequently

operated upon The course of the disease was so impressed upon the minds of the parents of this child that when acute symptoms developed they made a diagnosis of acute appendicitis with probable abscess formation and called in a local practitioner who confirmed the diagnosis, and upon their own initiative called in a surgeon

CASE REPORT—In an Illinois hospital a baby girl, two and a half years old, was admitted on the third day of an abdominal condition She was well developed Her history was negative up to a few months before, when she had several recurrent attacks

of pain in the right side accompanied by vomiting and recovery within two or three days The present attack began exactly as the preceding attacks, but the pain and tenderness in the right side progressively increased in severity, with gradually increasing temperature and pulse rate On the third day marked signs of sepsis appeared, with a distinct swelling in the right side

Physical Examination—Pulse

FIG. 2.—Another view of the gross specimen showing the ovary and a portion of the tube outer two-thirds The main ovarian tissue is seen as the lighter structure

130 Temperature 102.6 Respiration very rapid The child was very irritable and apparently very toxic The knees were flexed upon the abdomen and on palpation the abdominal muscles were found to be decidedly spastic A large mass could be made out in right lower quadrant causing a definite enlargement of that side of the abdomen Unable to obtain a blood count

Rectal Examination—Outlines of a large mass appeared in the right lower quadrant which had a very smooth, rounded surface, not typical of an appendiceal abscess yet very suggestive This mass was unable to be moved by digital manipulation No inflammatory reaction or enlargement about the uterus or vaginal tract was apparent No attempt was made at vaginal examination

Operation Under Ether Anesthesia—Upon gentle palpation with relaxed abdominal muscles the tumor mass changed in position from the right lower quadrant to a position higher and nearer to the umbilicus This definitely changed the diagnosis from one of appendicitis with abscess formation to one of a tumor Right rectus incision was made and a small quantity of blood-tinged fluid escaped A tumor mass the size of the fist of a mottled, reddish and bluish color was found originating in the right ovary and attached to a pedicle which was sharply twisted at the junction of the ovary with the Fallopian tube It was necessary to sacrifice the distal third of the tube as the extremity was completely involved with the tumor mass The abdomen was closed with No. 1 catgut without drainage and fine silk was used for the skin The child made an unevent-

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ful recovery and was discharged from the hospital in two weeks. There have been no further complications to date.

Pathology—Laboratory No 3432. Laboratory diagnosis,* dermoid cyst of ovary with hemorrhage. *Gross Description*—Specimen is a cyst measuring 8x6x7 cm. At one point there is an area about 4x3 cm, which is grayish-white in color and from the surface of which protrudes a small remnant of tube and a portion of the ovary measuring 2x1 cm. There is marked discoloration over the entire tumor and it appears very thin-walled except immediately surrounding the previously described area and a few



FIG 3—The upper portion shows blood and sebaceous material adjoining the inner lining of the tumor. The intermediate portion represented by the lighter area is chiefly adipose tissue. The more compact tissue below represents ovarian stroma but no follicles are present. The thinner strand of tissue represents the mesosalpinx and in the lowermost portion the tube lumen can be seen.

centimetres beyond this. On opening the cavity it is found to be filled with a bloody, turbid fluid which is a thin liquid. The entire cavity is coated with a coagulated material, chiefly blood. The inner stalk of the tumor seems to be directly over the area occupied by the ovary. Over this area there is a considerable amount of thick sebaceous material and a small amount of hair. Sections taken through the area overlying the ovarian tissue.

Microscopic—Sections of the tumor wall show a great deal of hemorrhage between the fibrous tissue strands. No ovarian tissue recognized. The cavity is lined by squamous epithelium and there are numerous hair follicles beneath the epithelium. No sebaceous glands seen in sections studied. There is no evidence of malignancy. There is also a considerable amount of adipose tissue in the periphery of the wall of the tumor. In the outer half of the wall the blood-vessels are markedly dilated. There is no evidence of thrombus formation however. There is considerable infiltration with polymorphonuclear leucocytes in the more peripheral portion of the wall.

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Diagnosis—Teratoma of ovary Simple dermoid cyst Hemorrhage into wall due to twisting of pedicle

Discussion of Operation—Children and young infants stand ether anaesthesia very well in fact, it has long been the anaesthetic of choice for children as well as for adults The reason for this comment is that one often finds

that chloroform is still used in children A number of abdominal operations have been successful at the St. Louis Children's Hospital under local anaesthesia, particularly a large series for pyloric stenosis The suckling child is quieted by being given a nipple or a pacifier throughout the operation under a local anaesthetic

The most annoying complication during the operation is the sudden forcing out of the intestines through the abdominal incision The replacing of intestines invariably prolongs the operation and is a decided factor in the production of shock In pyloric cases this happens only about once in ten cases

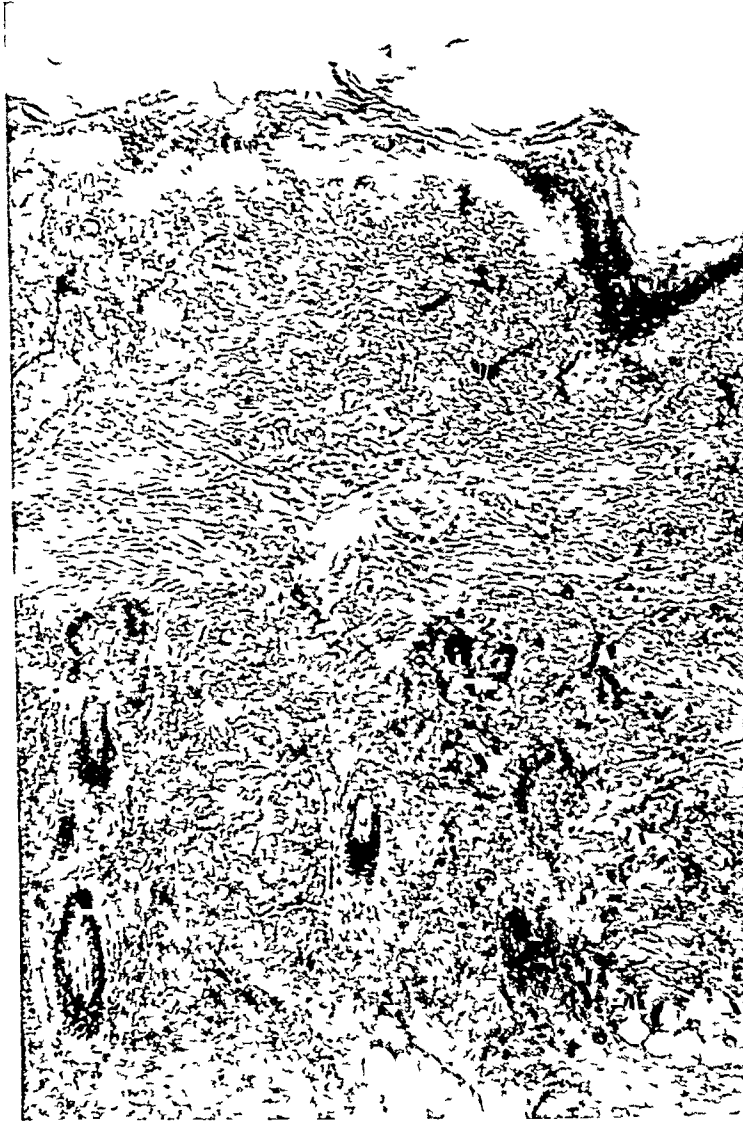


FIG 4—Inner portion of the wall of the tumor Wall is markedly infiltrated with blood which obscures its structure Squamous epithelium is well seen at the top In the lower half of the picture are seen numerous small hair follicles Note a small amount of adipose tissue

Comments This case only further emphasizes the great similarity of symptoms between acute appendicitis and ovarian tumor with twisted pedicle In both nausea and vomiting are common symptoms, also abdominal cramps and localized pain in the right side Unless the case is seen early in the attack or the abdominal tumor has been previously noted, the diagnosis would be very difficult to make and can only positively be made upon the rectal examination This further emphasizes the extreme importance of rectal examination

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in all acute abdominal conditions in children. It does not seem that a vaginal examination would be of any help, except in such cases as had a vaginal discharge where a malignancy involving the vagina or cervix were considered, but certainly not as a diagnosis of an intra-abdominal lesion.

BIBLIOGRAPHY

- ¹ Harry A. Wiel. A Survey of Ovariectomy at Extremes of Life. Johns Hopkins Hospital Bulletin, March, 1905, p. 102.
- William A. Downes. Tumors of the Ovary in Children. Journal of the American Medical Association, Feb. 12, 1921.
- ² Von Dr. W. Mittelstaedt. Kinderarzt in Gera, from the Munchener Medizinische Wochenschrift-Stieldrehung eines Ovarialtumors beim Kinde, No. 21, May 25, 1923.
- ⁴ Carmaby and Howard. Lancet, London, 1886, vol. 1, p. 920.

ANEURISMS OF THE ILIAC AND FEMORAL ARTERIES

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IN the spring of 1923, within a short period of a few months, three cases of aneurism of the iliac and femoral arteries of unusual interest were operated on in the John Sealy Hospital, surgical clinic. One was a traumatic arteriovenous aneurism of the femoral vessels in the middle portion of the femoral (Hunter's) canal in which both femoral artery and the terminal branch of the profunda femoris communicated directly with the femoral vein by separate fistulous openings. Another was a spontaneous aneurism of the external iliac artery and the upper portion of the femoral which was completely consolidated proximally but open distally from the origin of the profunda. The third was a spontaneous aneurism of the distal portion of the common iliac artery and the whole length of the external iliac trunk, in which ligature of the common iliac trunk six months previously had failed to effect a cure. The method of treatment was radically different in each of the cases.

The following case reports are presented with brief comments in the hope of adding a little to our rapidly growing knowledge of arterial surgery.

CASE I—*Arteriovenous fistula between the femoral artery and vein treated by ligation of the artery proximally and distal to the anastomotic opening* E S, male, colored, aged thirty-nine, hospital No 132,182. The patient was admitted to the John Sealy Hospital, November 8, 1922, for treatment of ulcers of the left leg which were thought to be syphilitic. He was found to have an aneurismal varix affecting the left femoral artery in the middle third of the thigh. After a month's rest in hospital he was discharged. He was readmitted January 16, 1923, for operation on the aneurism.

Past History—He contracted gonorrhœa eight years ago, and a venereal sore, probably syphilitic, five years ago. Three years ago was shot through the middle of the left thigh with a No 38 bullet, which penetrated the limb from the medial to the lateral side, producing an open comminuted fracture of the femur. The fracture was plated through a long incision on the lateral side of the thigh. Union was satisfactory and the plate stayed *in situ* without causing any trouble. Soon after getting up on crutches he noticed a fulness and pulsation on the inner side of the thigh near the healed bullet wound, and complained of a beating and vibration in the affected limb. He never regained full use of the leg. It remained thinner and weaker than the sound one. The circulation was very defective. The skin remained dry and lost its elasticity. Superficial ulcers were constantly appearing without adequate cause.

Present Illness—A few months ago several ulcers appeared spontaneously over the shin bone and the front of the ankle. Since they showed no tendency to heal, while the patient walked about, he was admitted to the hospital wards.

Physical Examination—The patient was fairly well nourished. He limped on his left leg. The whole leg from the groin down was much thinner than the sound leg. Below the knee the skin was rough, ichthyotic and inelastic. Several small indolent ulcers were present in the lower third, over the shin bone, and over the front of the ankle. The granulations on the ulcerated surface were indolent and the discharge was scanty and inodorous. The circulation in the skin was very defective. Below the knee the whole leg was slightly swollen and œdematous. In the middle of the thigh on its medial

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aspect one could see a small round scar caused by the entrance of the bullet. On the lateral aspect of the thigh there was a scar about five inches long over the site of the bone plate which had been used to fix the fractured femur. Bony union was firm and massive. On palpating the femoral vessels on the medial side of the limb, a vigorous thrill was felt. It was most intense in the neighborhood of the bullet wound, but was quite perceptible along the whole course of the femoral vein as high as the inguinal ligament. It was very indistinct in the popliteal space, and imperceptible in the tibial arteries at the ankle-joint. On auscultation along the line of the femoral vessels one could hear a loud "bruit." This also was most intense below over the bullet wound and diminished as one approached the heart. The bruit was faintly transmitted into both tibial arteries as far as the ankle. Traced proximally, it was very intense as far as the groin, was fainter in the iliac fossa, and fainter still over the vena cava inferior. It was quite distinct over the lower portion of the sternum and ensiform cartilage and over the right auricle. The quality of the bruit was characteristic. It had the continuous roaring sound like that of distinct machinery or of a train passing over a bridge, which is so characteristic of arteriovenous aneurism. The roaring sound was continuous during the whole cardiac cycle. It reached its maximum intensity at the height of each pulse wave and faded gradually in the intervals. The femoral artery was uniformly dilated to twice its normal size from the inguinal ligament to the level of the fistula. At the level of the fistula the dilatation was greatest. Below the fistula arterial pulsation was very feeble and the vessel was apparently smaller than normal. There was no suggestion of an aneurismal sac in any portion of the dilated artery. On applying carefully graduated pressure on the artery with the point of the forefinger over the site of injury both thrill and bruit disappeared. The proximal portion of the artery remained distended and continued to pulsate. Digital pressure on the femoral artery just below the inguinal ligament stopped both thrill and bruit. Examination of the heart showed no evidence of enlargement or of dilatation or hypertrophy. Unfortunately no examination was made to determine the Branham brachycardiac phenomenon.

A diagnosis of aneurismal varix was made. Everything pointed to the absence of an aneurismal sac and to the presence of a direct opening between the femoral artery and vein. The absence of pulsation in the artery below the wound and the feeble circulation in the leg showed that most of the arterial blood from the femoral artery was passing through the opening into the femoral vein, and thence proximally towards the heart. The transmission of the loud bruit upwards towards the right side of the heart corroborated this view. The circulation of blood through the leg in the parts supplied by the femoral artery distal to the lesion was so feeble that we felt certain that very little blood was passing along the distal portion of the vessel. The efficiency of the collateral circulation was a matter of surmise. It was reasonable to believe that the plating operation had injured the descending branches of the lateral circumflex vessels considerably, but we had no accurate means of finding out how much damage the terminal branches of the profunda femoris and the perforating arteries had received by the passage of the bullet. It was, therefore, necessary to test the efficiency of the collateral circulation before attempting an operation which might cut off the direct circulation completely. This was done in the following manner. The whole limb was rendered bloodless by bandaging it firmly with a rubber bandage from the toes to the groin. An Esmarch tourniquet was then wound around the thigh, above the limit of the rubber bandage, tight enough to prevent any arterial blood from entering the limb. The rubber bandage was then removed, but the Esmarch tourniquet left in place. Pressure was then made on the femoral artery below the origin of the profunda femoris by a special tourniquet made after a pattern described by Matas as the "Massachusetts Hospital tourniquet" (A Carte tourniquet would serve the purpose). By means of this instrument the femoral vessels were compressed against the femur, but no pressure was brought to bear on the terminal branches of the profunda femoris. As soon as the pad of this tourniquet was in place, the Esmarch tourniquet was removed from the upper part of the thigh, and

circulation was restored in the femoral and profunda trunks. As blood could only pass into the leg through the profunda artery alone and its anastomoses with the geniculate and arteria genu suprema below, the restoration of circulation, which was shown by the gradual descent of a red blush, was proof that the collateral channels were patent and adequate.

Tests were made on several occasions on separate days under the following conditions. In one set of tests, pressure was made on the femoral artery proximal to the fistula, in the other, pressure was made directly on the fistula. In the former the circulation was restored without a halt in less than a minute. In the latter the return of circulation was very slow. At the end of three minutes the toenails began to show some color, but even at the end of ten minutes the circulation was very feeble. The quick return of blood to the leg and toes proved that it was safe to arrest the circulation in the femoral artery at any point between the origin of the profunda and the opening into the vein, but the slow imperfect return when the site of anastomosis was compressed showed two facts conclusively, (1) that the collateral arterial trunks derived from the termination of the profunda femoris were very closely applied to or incorporated with the aneurismal varix, and (2) that their integrity and patency were essential to the life of the limb if by any chance the main trunk of the femoral artery should be occluded. While absolute proof was impossible, we were very suspicious that the profunda femoris opened into the femoral vein and participated in the arterio-venous anastomosis.

Operation, (January 26, 1923), gas-ether. A long incision was made through which the femoral artery was exposed from a point just below the origin of the profunda femoris to the lower end of the adductor canal. The femoral artery proximal to the opening into the vein was dilated to twice its normal size and pulsated vigorously. Distal to the opening it was contracted and no pulsation was present. It was adherent to the vein for a distance of at least three-quarters of an inch and the sides of the vessels were fused together so firmly that it was impossible to dissect them apart or to find a neck of communication. The artery was separated from its sheath at a point about an inch above and at another point about an inch below the fistula. Traction threads were carried around the vessel at these places to facilitate the application of the artery clamps. The vein was treated in a similar manner. The walls of the veins were thin and pulsation was very vigorous. The dissection of the veins was difficult and tedious. A rubber-covered clamp was then placed on the artery proximal to the opening. Pulsation and thrill ceased in both parts of the veins. Another clamp was placed on the distal portion of the artery without producing any changes. Then the distal part of the vein was clamped without producing any change. Finally the proximal end of the vein was clamped. Immediately the site of the aneurismal varix between the clamp began to fill up slowly with blood until it became as large as a hen's egg. The distention was so great that I was afraid that the vein would burst, and to prevent such a catastrophe, the proximal clamp was loosened. The vein collapsed immediately. The manœuvre was repeated several times with identical results. The segment of vein became distended like a toy balloon and as far as we could make out neither pulsation nor thrill could be detected. It was, nevertheless, clear that a fair-sized artery communicated with the segment of vein between the clamps and that the *arteriovenous fistula was double and not single*. The site of the main fistula was almost exactly in the middle of Hunter's canal, at which level the vein lies posterior to the artery. Exposure of the vein had been very difficult. Its posterior surface at the site of the fistula was firmly connected with the adductor longus muscle and there was great probability that any further attempt to liberate it would result in tearing its walls. The accessory fistulous opening was situated on its deep or posterior surface in a very inaccessible position. The artery opening into the vein in this situation could only be the terminal trunk of the profunda femoris or one of its branches. (Fig 1)

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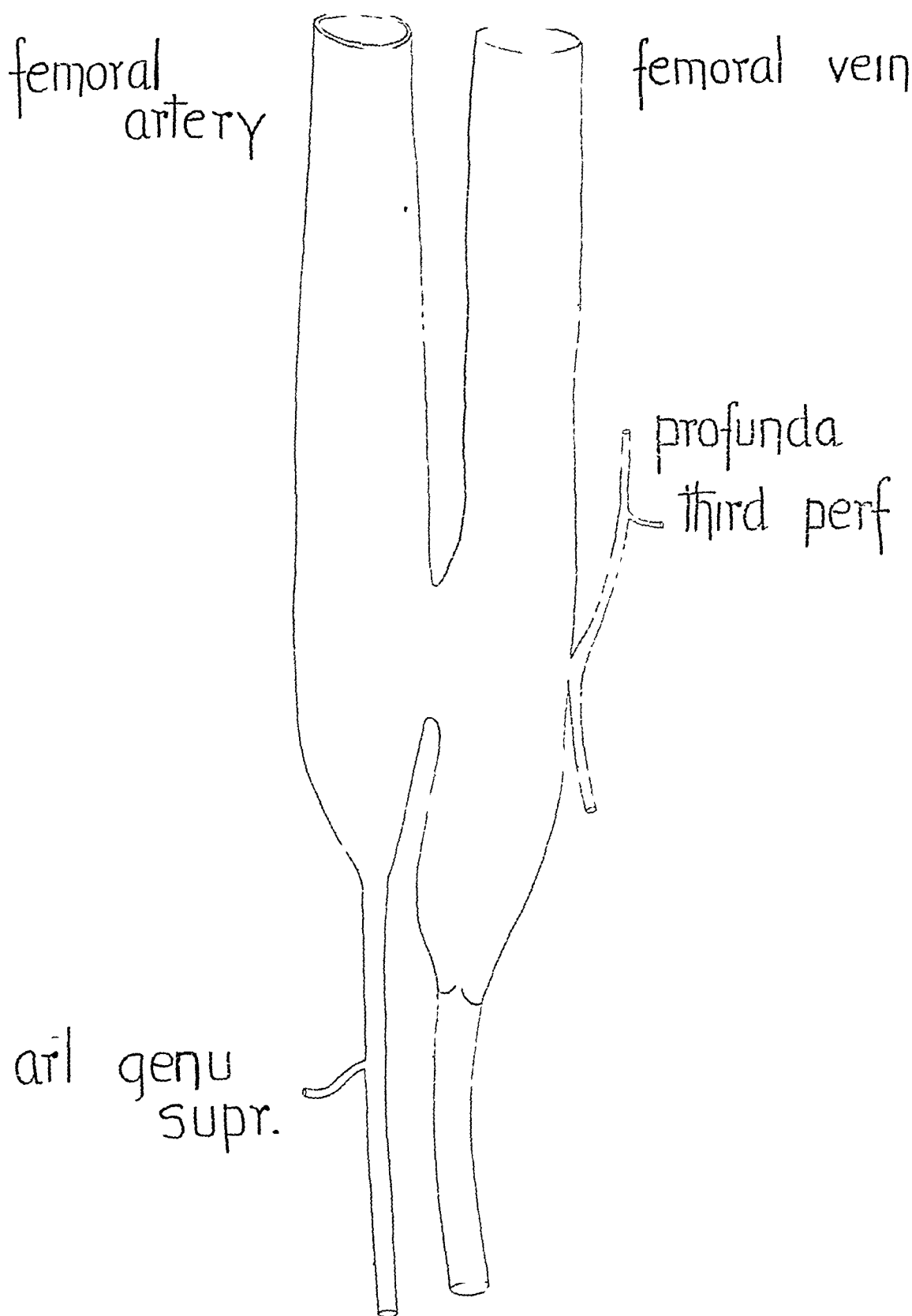


FIG 1 —Arteriovenous fistula between the femoral artery and vein. The profunda artery is shown opening into the vein also. Note the small size of the artery distal to the fistula, also the competent valve in the vein distal to the fistula. (Case I)

We were strongly tempted to control the arterial circulation in the profunda femoris, by placing a clamp on the femoral artery above its origin, and to continue with the operation, for our object had been to make a transvenous suture of fistulous opening into the artery according to the Matas-Bickham method. Considering, however, that the

collateral circulation through the branches of the lateral circumflex artery had been seriously damaged by the plating operation on the femur (Fig 8) and that the tests of the efficiency of the collateral circulation showed that deep pressure over the site of the fistula seriously jeopardized the circulation of the limb, we concluded that it was very dangerous to run the risk of wounding the profunda femoris, because it was evidently the only really competent collateral channel. Consequently we abandoned the trans-venous route and finished the operation by dividing the femoral artery between ligatures, proximal and distal to the fistulous opening. While placing the ligature on the distal end of the artery the origin of the arteria genu suprema was found arising from its trunk between the ligatures. It was secured and tied near its origin. We were somewhat worried over this at first, because we thought we had cut one of the important anastomotic channels. No bad effects, however, followed. The immediate result of the ligature and division of the main femoral trunk was very satisfactory. Pulsation in the vein stopped at once. We were not so certain about the thrill. An almost imperceptible vibration could be felt in the vein. The wound healed kindly. A few days after the operation an unmistakable thrill was felt at the site of the original trouble. It was, however, feeble in character and was heard very faintly in the groin. It showed no tendency to increase in intensity during the period the patient was kept under observation (four months). The circulation of the leg and foot was never embarrassed. Rapid improvement in nutrition was noticed at once. Oedema disappeared. The skin lost its dry character and became moist and supple. The ulcer healed up rapidly. When the patient was discharged from the hospital, two months after the operation, he was able to walk without discomfort.

Such a favorable result was unexpected. The operation was anatomically and physiologically incomplete, because we had failed to shut off every avenue of communication between the arterial and venous channels. Some arterial blood, we had no means of gauging how much, was still flowing into the femoral vein from the profunda femoris artery or one of its branches. We had succeeded in shutting off the communication between the femoral artery and vein, but nothing more.

A study of the physics of the circulation in the presence of an arterio-venous fistula shows that profound changes occur not only in the veins in the immediate neighborhood of the fistula, but in the arterial system proximal to the fistula and even in the heart itself. The heart frequently shows myocardial insufficiency with marked hypertrophy and dilatation. The artery proximal to the fistula is occasionally dilated to a huge size, the external iliac sometimes resembling the abdominal aorta (Halsted). The reasons for these changes are somewhat complex, but they probably arise primarily in the necessity for a higher blood-pressure in the part of the body supplied by the artery in which the fistulous opening has been made. Thus the leg in the case of a fistula between the femoral artery and vein is in sore need of blood, and a proper quantity cannot be obtained unless the volume flowing down the main femoral artery is large enough to fill the artery distal to the fistula, even though the greater part of it passes through the cut-off into the vein. Such an ideal condition probably never occurs. The limb is invariably badly served, but the physiological stimulus is constantly acting to bring the ideal conditions about. This entails, not alone hypertrophy of the left heart, but owing to the increased size of the arteries and the increased volume of blood reaching the heart

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through the fistulous opening, it leads to an increase in size, of the heart chambers and frequently to dilatation. The local conditions are easier to understand. In the immediate neighborhood of the fistula the blood-pressure in the artery and vein is nearly equal. This increased venous pressure remains constant as far as the first set of distal valves which are competent. They close at once. In a proximal direction towards the heart the pressure decreases rapidly, because there is ample room for expansion in the highly distensible veins which carry the flow towards the heart. Towards the periphery, however, no blood can possibly pass through the valves in either direction. It is impossible for the blood-pressure to rise high enough on the distal side of the valves to force them, because it would presuppose that the venous circulation was under a higher tension than the arterial. It is also impossible for the valves to be forced from the proximal side, because that would mean the reversal of the circulation. Therefore, the blood peripheral to the valves is forced to make its way around the obstruction in a circuitous manner through the muscles and other tissues until it communicates with veins which open into the main vein away above the obstruction where the higher pressure has faded away and where it is possible for the venous blood to discharge itself into the general current. In the case of a fistula in the lower portion of the femoral vein the pressure at the opening of the profunda vein into the main trunk is probably low enough to allow the exit of blood without much difficulty. Under these conditions the blood in the femoral vein near the anastomosis would be purely arterial and there would be no mingling of arterial and venous streams until it reached the opening of the profunda vein into the main trunk. The embarrassment of the venous circulation would be relieved at once by closing the fistulous opening by any method, either by ligature of the artery above and below the opening (exclusion) or by direct suture of the edges of the fistula. The moment the blood-pressure dropped in the vein the valves would open and the flow of venous blood would follow its normal channels.

In the case reported, although a slight flow of arterial blood still passed directly into the vein, the blood-pressure did not reach such a high level as before and consequently the current of venous blood passing along the femoral vein was unobstructed.

CASE II—*Partially consolidated ilio-femoral aneurism extending distal to the origin of the profunda femoris. Excision of aneurism, including iliac and femoral veins. Cure.* Tom Thomas, male, colored, aged forty-three, was admitted to the John Sealy Hospital complaining of intense pain in the anterior surface of the right thigh. On examination an oblong tumor was found situated along the line of the external iliac and femoral arteries. It extended from a point about two inches above the inguinal ligament to the middle of Scarpa's triangle. The greater part of the mass was hard, nodular and homogenous. On its superficial surface several movable nodules, like lymph-nodes, could be palpated separately. It was firmly fixed to the deeper parts. The upper end passed posterior to the inguinal ligament. Neither pulsation, nor thrill nor bruit could be distinguished.

The history of the patient showed that he had formerly suffered from typhoid, malaria and rheumatism, and that he had contracted a chancre at the age of twenty-one, and gonorrhœa seven years ago. He was shot in the right buttock in 1916, and although

no wound of exit was found, the bullet could not be located. At the present time the Wassermann reaction is negative.

The swelling in the groin and the upper part of the thigh was noticed first about six months ago. Its increase in size has been gradual. Except for the pain along the cutaneous branches of the femoral nerve and slight œdema of the leg below the knee he suffers little.

Diagnosis—At first the tumor was thought to be either an inflammatory or a malignant growth situated in lymphatic glands lying on the medial side of the femoral and external iliac veins. Later on we came to the conclusion that it was probably an aneurism which had become consolidated in the greater part of its extent. Its position along the line of the artery, complete absence of pulsation in the femoral artery below and in either tibial, neuralgia in the branches of the femoral nerve, uniform fusiform shape, very slow growth, and the absence of any source of infection to cause an adenitis were all in favor of such a conclusion.

My advice was to leave matters alone and to give potassium iodide and tonics internally. The patient persisted in his requests for operative removal under the plea that the pain was intolerable and that he was convinced that the growth of the tumor was progressive. I consented reluctantly.

Operation, (March 9, 1923). A vertical incision was made along the line of femoral and external iliac artery reaching from a point four inches above the inguinal ligament to the middle of thigh. The oblique abdominal muscles and the transversalis were divided and the upper portion of the external iliac artery was exposed by the retro-peritoneal route. The external iliac vessels were exposed above the tumor and examined carefully. The artery was small and completely collapsed. No blood was passing through it. The vein was also small but on compression it was found to contain blood. Both vessels were traced to the upper end of the tumor with which they fused. The dissection was now carried into the upper part of the thigh. The femoral artery and vein were traced upwards to the lower pole of the tumor. Both were distended and apparently full of blood. It was evident that the collateral circulation had been established through the crucial anastomosis and that a considerable amount of blood was flowing up the profunda femoris into the main trunk and thence distally into the legs. We had no means of finding out how adequate the collateral circulation was through the terminal branch of the profunda femoris and whether the vitality of the limb would be imperilled if the reflux arterial current up the profunda into the femoral artery should be cut off. We felt that gangrene would inevitably follow if the posterior anastomoses were inefficient. After some hesitation we took the risk and excised the aneurism. The external iliac artery and vein were divided above between two ligatures. The aneurism with the vein closely incorporated in its wall was then dissected from the side of the pelvis without difficulty. As the dissection approached the inguinal ligament the femoral nerve came into view on the lateral side of the aneurism. It was retracted outwards and guarded carefully from injury during the dissection of the distal part of the tumor from the thigh. The deep circumflex iliac and inferior epigastric arteries did not bleed when they were cut. The dissection below the inguinal ligament was more difficult. The tumor was lifted up from the pectineus muscle and the external pudendal arteries divided between clamps. The medial aspect of the tumor was separated from the adductor brevis. The femoral artery and vein were then divided between two ligatures just below the lower end of the tumor and the lateral and posterior connections of the tumor isolated and divided. This part of the operation necessitated the division of the profunda femoris artery and vein. Both vessels were patent. After ligature of these trunks the wound was dry. (Fig. 2 is a sketch of the dissected aneurism.)

Feeling some anxiety about the peripheral circulation the toes were examined and blood was seen to circulate around the bases of the nails.

The convalescence was without incident. The wound healed kindly. Circulation in the foot was never embarrassed and the limb was free from œdema. The patient was

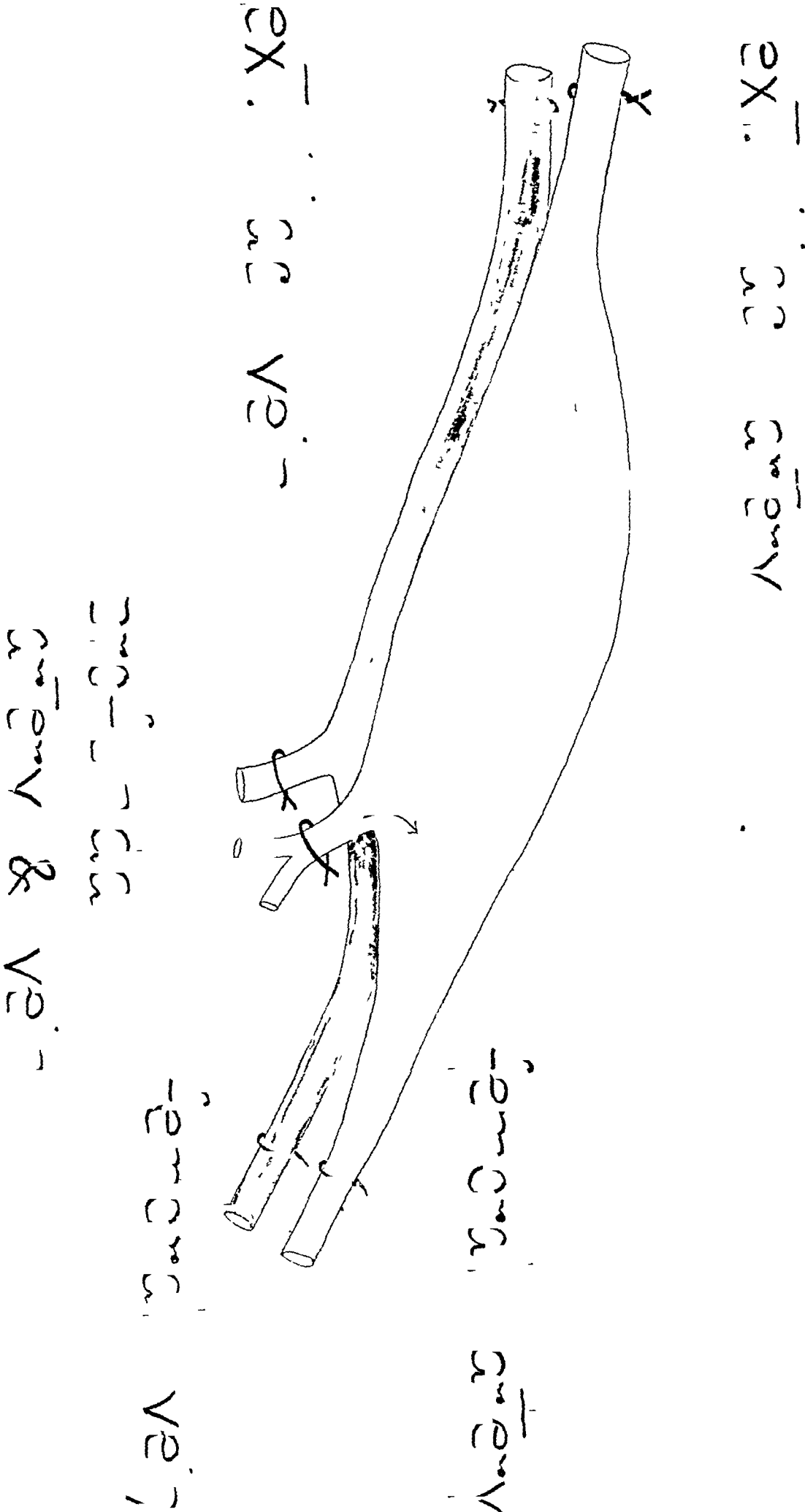


Fig 2.—Rough sketch of the consolidated aneurysm removed by excision in Case II. The distal portion of the aneurysmal sac was not consolidated. Blood was circulating sluggishly (up-stream) along the profunda into the site and thence distally along the femoral. The femoral vein was patent.

allowed to sit up during the third week, and in a short time the leg and foot became œdematous. In the recumbent posture the œdema disappeared, but it always returned when the patient stood upright. At the present time of writing this condition persists. (Edema disappears during the sleeping hours, but comes back promptly when the leg is used.

Remarks Excision of aneurisms can never be considered an ideal procedure. It is probably the most dangerous method of treatment. It is certainly the most difficult from a technical standpoint. It involves the removal of the vein in almost every instance, because the vein is so closely incorporated with the sac wall that they cannot be separated. They can hardly be dissected apart in the dead house.

In this case it would have been wiser not to have operated. The aneurism would probably have cured itself and undergone complete consolidation, and the femoral vein would have been kept intact. We should in this way have avoided the intense œdema which followed the operation. Even if the aneurism had not consolidated completely, but had continued to increase at its lower end, it would have been better to have obliterated the artery and the aneurismal sac and left the femoral vein untouched. An intrasaccular suture (old operation, Antyllus-Matas) would have cured the case with no greater risk of gangrene than excision and with a much better prospect of restoration of venous circulation.

CASE III—*Spontaneous aneurism of the left external iliac artery involving bifurcation of common trunk, ligature of common iliac unsuccessful, subsequent ligature of right internal iliac unsuccessful, distal ligature of left femoral followed by immediate hemorrhage, old operation (Antyllus) performed at once, followed by a cure* C F, colored man, aged twenty-seven, was admitted to the John Sealy Hospital in June, 1922, suffering from bilateral inguinal adenitis of gonorrhœal origin. He had a clear history of syphilitic infection, and the blood, Wassermann, was 2 plus positive. The suppurating glands were removed from both groins. A few days afterwards he complained of severe pain in the left groin and we found a pulsating swelling along the line of the external iliac artery. This proved to be an aneurism.

On September 2nd, through a transperitoneal incision through the left rectus muscle, the left common iliac was tied by my colleague, D A O Singleton. Umbilical tape was used as the ligature. The left inferior epigastric artery was divided and tied during the operation. The aneurismal sac occupied the whole length of the external iliac artery and overlapped the bifurcation of the common trunk at its upper end. The patient was discharged at the end of a month apparently cured. Convalescence had been ideal. The circulation of the thigh and leg was good and no pulsation could be detected in the sac.

He was readmitted on March 19, 1923, with a return of pulsation in the aneurism. The sac was large and extended upwards from the inguinal ligament below almost as high as the umbilicus above. It filled the whole of the left iliac fossa and extended to the right as far as the middle line. Expansile pulsation was present. It was, however, less vigorous than before the operation. The bruit was well marked. The patient suffered from considerable pain referred mainly to the terminal branches of the femoral nerve in the thigh.

On March 28th the right internal iliac artery was tied with braided silk. The abdominal cavity was opened by a median incision and the aneurismal sac and left iliac arteries examined carefully. The sac had increased in size since the last operation. It now occupied the lower third of the common and all the external iliac trunks. (Fig 3.) Proximal to the upper end of the sac the common iliac trunk seemed to be obliterated. No

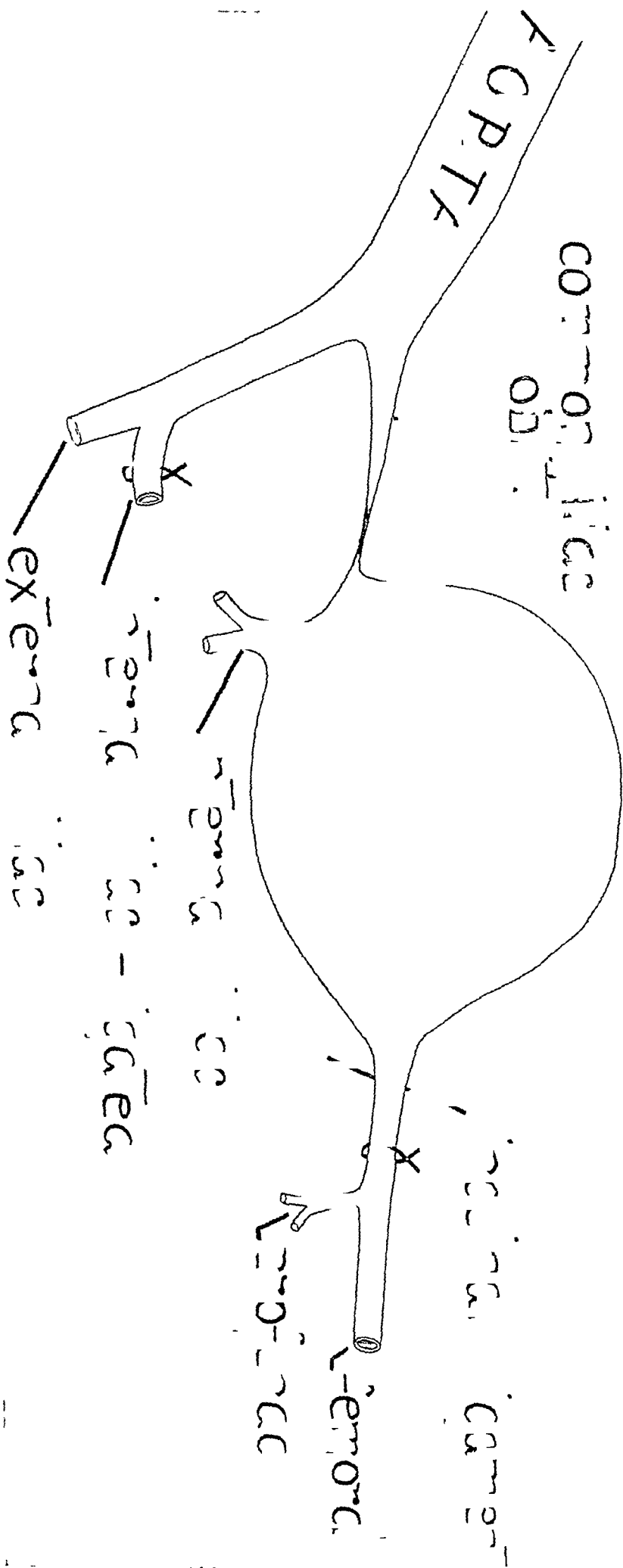


Fig. 3.—Sketch of the anatomical condition found in Case III at the time of the second operation. A ligature was placed on the right internal iliac. The ligature shown on the common femoral trunk was not placed there until the third operation. Note the complete obliteration of the left common iliac artery as the result of ligature at the first operation.

pulsation was present over the line of the artery and we could find no trace of the ligature that had been placed on it six months before. The left internal iliac artery could not be found. It appeared to be covered by the upper end of the sac. The ureter was dissected off the lateral wall of the pelvis and the side of the aneurismal sac, and an unsuccessful search was made for the internal iliac artery and its branches. As a last resort, in the hope of cutting off the anastomosis between the branches of the right and left internal iliac vessels, the right internal iliac artery was ligatured.

Pulsation was not very vigorous either before or during the operation. Compression of the right internal iliac appeared to stop it, and after the ligature was tied it was imperceptible. A few days after the operation, pulsation and bruit returned, showing that we had failed to find the collateral arterial branch which was bringing blood into the sac. We were uncertain as to its location. Thinking that it might come from below through the branches of the medial and lateral circumflex arteries *via* the profunda femoris and femoral we applied digital pressure on the femoral trunk just below the inguinal ligament. The test was unsatisfactory, because on account of the scar tissue left by the operation on the suppurative hubo and the absence of pulsation in the femoral it was impossible to tell if pressure had been applied correctly. It seemed more probable that blood was flowing into the sac through some of the branches of the internal iliac of the same side or perhaps through an aberrant obturator artery. The inferior epigastric and deep circumflex arteries were taken into consideration, but we did not think it likely these vessels could be responsible for the persistence of the aneurism, because the lower end of the sac barely reached the level of the inguinal ligament. In addition, we had reason to believe that the inferior epigastric had been divided in the rectus abdominis sheath when the common iliac was tied. Believing that distal ligature of the femoral artery would stop the circulation through the sac, the operation was performed on April 16, 1923. It was necessary to expose the artery thoroughly in order to be sure of placing the ligature above the origin of the profunda femoris. To have shut off the profunda from the main femoral trunk would have been a blunder that would probably have been followed by gangrene of the leg because it serves as one of the main collateral channels through which arterial blood reaches the thigh and leg after ligature of the common or external iliac or common femoral trunks. The profunda arose at an unusually high level just below the inguinal ligament. The inguinal ligament was divided and the femoral artery followed upwards until the lower end of the aneurismal sac appeared. A silk ligature was placed on the artery about an inch below the sac (Figs 3 and 4). When it was tied it cut its way through the walls of the vessel as if they had been made of cheese. The proximal end of the artery began to bleed at once. It was seized with a pair of artery forceps, but the walls were so soft that the forceps would not hold. After several abortive attempts had been made to catch the bleeding end and tie it, the nose of the artery forceps slipped into the aneurismal sac and a furious gush of arterial blood occurred. The opening was plugged with gauze while we held an anxious consultation over the case. We came to the conclusion that the old operation (Antyllus-Matas) offered the only good chance of success. It was necessary, however, to get control of the proximal circulation. We had already tied the common iliac and had nothing left but the abdominal aorta. Accordingly, we opened the abdominal cavity and exposed the abdominal aorta and passed a ligature around it. The ligature was not tied, but served as a loop against which the artery was compressed by the finger of an assistant. To our amazement, compression of the abdominal aorta failed to stop pulsation in the sac. It was, however, impossible to abandon the patient, so we were under the necessity of opening the aneurismal sac without control of the proximal circulation and trust to our dexterity and luck to reach and control the bleeding vessel. The sac was opened in front by a long incision which divided the abdominal muscles which covered it. Furious arterial bleeding came from the upper and hinder part of the sac which was funnel-shaped. The bleeding stopped when the funnel was blocked with the tip of the forefinger, or when it was packed tightly with gauze. After trying in vain to get a view of the interior of

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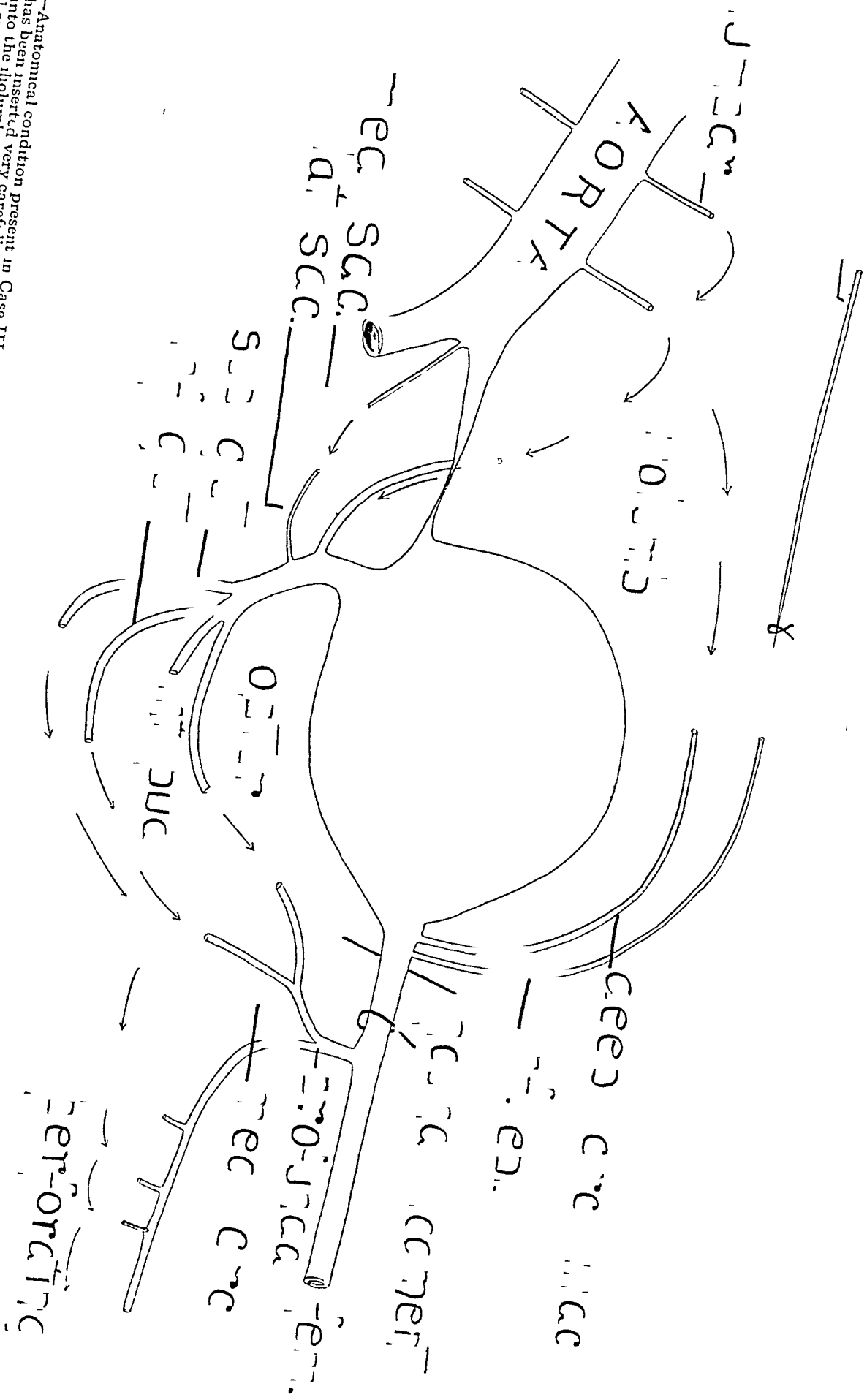


Fig 4 — Anatomical condition present in Case III at the time of the third operation when a ligature was placed on the common femoral trunk at its origin. The collateral circulation has been inserted very carefully. It shows that practically all the blood comes from the same side (left) through the lumbar aortic branches and middle sacral artery both femoral circumflex arteries. The anastomosis of the obturator with the medial femoral circumflex is also shown. It is sometimes very important. In this case the inferior epigastric and the deep circumflex iliac did not enter into the anastomosis because they were shut off by the ligature placed on the femoral.

the sac for the purpose of stitching up or clamping the bleeding aperture, we succeeded with some difficulty in carrying a strong ligature around the neck of the funnel by means of a curved needle which was passed from the interior of the sac, guided by the left forefinger, which served as a temporary plug. The ligature was tightened as the forefinger was withdrawn, and knotted tightly. Our anxiety was intense. Happily, bleeding ceased at once. The rest of the sac wall was inspected, but no other arterial openings were found. The cavity of the sac was then packed lightly with iodoform gauze, the ligature withdrawn from around the abdominal aorta and the abdomen closed.

The patient made an uninterrupted recovery. The circulation in the leg was never embarrassed at any period. He left hospital May 27th, with a perfect leg. During convalescence he complained of pain in his left upper chest. X-ray examination showed a small aneurism arising from the left side of the transverse portion of the thoracic aorta.

The most puzzling feature of the case was the failure to control circulation through the aneurismal sac by compression of the abdominal aorta. It can only be explained by the opening up of the anastomotic channels between the lumbar branches of the abdominal aorta and the parietal branches of the internal iliac, as a result of the ligature of the common iliac seven months before.

A study of the attached diagrams and legends will explain both the normal and pathological anatomy of the condition.

In Fig 5 we see a view of the left side of the pelvis which shows the normal anatomy of the common iliac artery and its branches. The branches of the internal iliac stand out very clearly. Proximally we see the ilio-lumbar artery passing upwards under cover of the psoas magnus to anastomose with the lumbar branches of the abdominal aorta and with the deep circumflex iliac. Then in order we see the lateral sacral, the superior gluteal, the obturator, the inferior gluteal (O T sciatic), the internal pudendal, and middle hemorrhoid arteries. From the distal end of the external iliac two trunks arise, *viz*, the inferior epigastric and the deep circumflex iliac.

In Fig 6 the anastomoses between the ilio-lumbar, deep circumflex iliac and the lumbar branches of the abdominal aorta are shown. Also those between the medial and lateral sacral arteries.

In Fig 7 the anastomoses between the superior gluteal, inferior gluteal, medial circumflex and the perforating branches of the profunda are shown.

In Fig 8 the profunda femoris and its medial and lateral circumflex branches are shown to indicate the great importance of this artery in carrying on the circulation either directly or by means of its anastomosis. The arteria genu suprema, a direct branch from the femoral, is shown clearly.

In the following description frequent reference to these diagrams will be needed in order to understand the text.

After ligature of the common iliac artery blood passes into the lower extremity of the same side through the following channels (Figs 5 and 6), from the lumbar branches of the abdominal aorta into the lumbar branches of the ilio-lumbar artery, from the lumbar arteries into the circumflex iliac, from the middle sacral into the lateral sacral, and from the superior into the inferior epigastric artery. If we trace the stream passing in a retrograde direction

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upstream through the ilio-lumbar and lateral sacral arteries, we can see that it flows into the main trunk of the internal iliac artery and then divides into two currents. One passes proximally around the bifurcation into the external



FIG 5 — Modified from Spaltehoitz shows the anatomical relations of the left common iliac artery and its branches. The internal iliac trunk and its branches are brought into relief. The middle hemorrhoidal artery arises from the internal pudendal iliac (or aneurismal sac) whereas, the other flows distally into the other branches of the internal iliac. If the common iliac trunk had been ligatured for an aneurism of the external iliac, the stream of blood through the aneurism would be arrested if consolidation occurred. If, however, consolidation failed,

some blood would still circulate through the aneurismal sac, and, as time passed, the quantity would increase until pulsation was almost as vigorous as before. Consolidation of the aneurism would throw all the blood into the other branches of the internal iliac and the increased flow down the gluteal arteries would open up the anastomoses between their terminals and the branches of the medial and lateral femoral circumflex and the perforating arteries below (Fig 7) (crucial anastomosis). By this means, blood would reach the profunda femoris. This stream would divide also. Part of it would flow peripherally down-stream through its terminal branches to reach the anastomoses with upper geniculate arteries and *arteria genu suprema* by means of which it would reach the lower portion of the femoral and the upper portion of the popliteal trunks (Figs 7 and 8). The other part would flow centrally up-stream along the profunda until it reached its main trunk, thence into the femoral artery and so down the thigh into the leg.

The current of blood into the terminals of the deep circumflex iliac would come from two sources (Fig 6) from the lumbar branches of the abdominal aorta and from the ilio-lumbar artery. The current would flow centrally (up-stream) along this vessel and open into the external iliac just above the inguinal ligament. The current passing along the inferior epigastric (Fig 5) would be derived from the superior epigastric where the two arteries mingle with one another in the upper portion of the rectus sheath. It would also flow up-stream to join the current in the external iliac just above the inguinal ligament. Blood from these two latter sources would be of the greatest value in nourishing the thigh and leg. The importance of these arteries as carriers of blood into the external iliac below the aneurism is so evident that unusual care should be taken to save them from injury whenever the common iliac artery is tied. Consequently the rectus abdominis incision should never be used in intraperitoneal ligation of the iliac arteries. On the other hand, in cases of iliofemoral aneurism in which ligation of the common or external iliac has failed to stop the pulsation in the sac, it may be necessary to tie both of these trunks deliberately for the purpose of arresting recurrent pulsation.

Failure to cure an aneurism of the external iliac by ligation of the common iliac is caused by too much blood reaching the sac through the internal iliac artery of the same side. Wide open anastomoses decrease the risks of gangrene of the leg, but increase those of recurrent pulsation.

The risks of gangrene do not seem to be great, particularly if the aneurism is confined to the external iliac. If, however, the aneurism has encroached on the internal iliac and its branches or on the femoral where it gives off the profunda femoris, the risks are increased seriously. It has been pointed out by Halsted that ligation of the common iliac is less likely to be followed by gangrene of the limb than ligation of the external iliac. Although case records support this statement, it is impossible to accept it unreservedly without subjecting it to critical scrutiny. It is then revealed that the danger of gangrene is influenced more by the position of the aneurism than by the site of ligation and that spontaneous or operative cure of an aneurism is attended by its own

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peculiar dangers because it is followed by the blocking up of the only possible channels by which blood can reach the periphery. We have long known that complete consolidation of the sacs of many aneurisms of the abdominal aorta results in blocking up of the arteries arising from the sac and death of the organs supplied by these vessels. Thus, consolidation of an aneurism of the

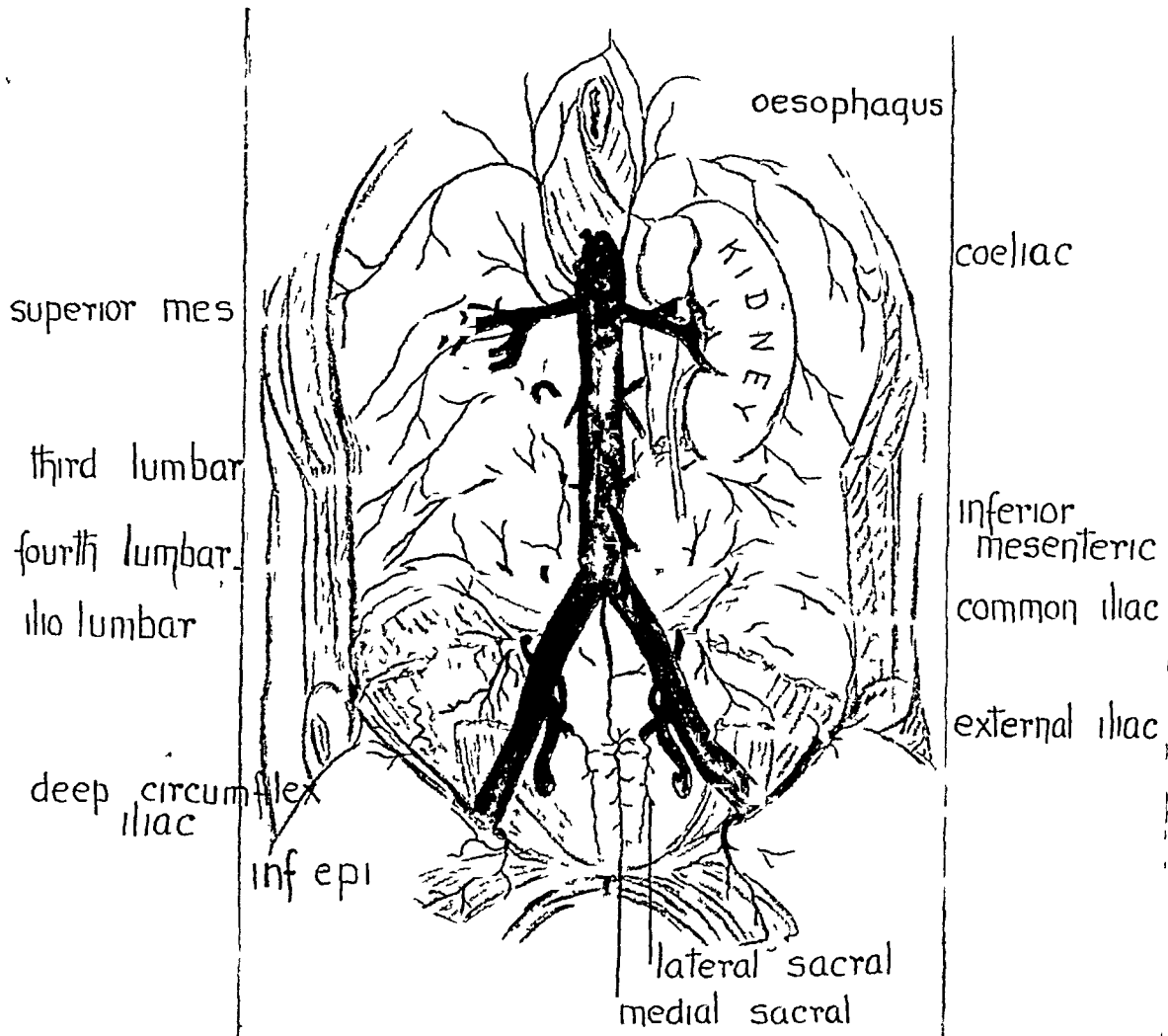


FIG 6 —Modified from Spalteholtz shows very clearly the anastomosis between the fourth lumbar artery and the ilio-lumbar, and between the medial and lateral sacral arteries

upper abdominal aorta will block up the renals or the superior mesenteric and produce necrosis of the kidneys and the intestines. Likewise, in considering the ilacs and their branches, we find in treating aneurisms of the gluteal arteries which occupy the direct posterior anastomotic channels carrying blood to the thigh, that ligature of the common iliac is quite a dangerous procedure, but that direct attack on the aneurism followed by ligature of the common iliac is more dangerous still, also that in ilio-femoral aneurisms, ligature of the external iliac is almost without danger of gangrene if the aneurism stops short of the origin of the profunda femoris, but that if the aneurismal sac includes the origin of the profunda femoris gangrene occurs more frequently, because consolidation of the sac excludes the circumflex arteries and the profunda trunk from the collateral circulation.

Recurrent pulsation, on the other hand, may often be "an angel in dis-

guise" As a rule it is a sure sign that the collateral circulation is efficient, in part at least, and it indicates that blood is reaching the sac in considerable quantity It is often difficult to say which one of the collateral branches is carrying blood into the sac, especially in some situations as in the lower portion of the neck and axilla, or whether more than one branch is engaged in the task, as happens very frequently in these regions In such arteries as the iliacs and femoral the collateral channels form such a definite row of anastomoses from above downwards that there is less uncertainty, and one can apply the laws of probability with less chance of error When recurrent pulsation appears in an iliac aneurism after the common iliac artery has been tied, almost all the blood reaching the sac is derived from the internal iliac of the same side A small quantity may be derived from the opposite internal iliac through the anastomoses between the communicating uterine, internal pudendal and middle hemorrhoidal arteries, but it is probably negligible Blood flowing through the inferior epigastric, the accessory obturator and the deep circumflex iliac would exert an influence only on aneurisms of the lower part of the external iliac and the upper part of the femoral The internal iliac is so large an artery and has so many large and important branches that it is rather surprising, on reflection, that any aneurism of the external iliac undergoes consolidation after ligation of the common trunk alone The volume of arterial blood coursing centrally (up-stream) along the ilio-lumbar and lateral sacral branches into the main trunk must be considerable, and if the gluteal arteries are not wide open enough to transmit it readily to the posterior aspect of the thigh, a large part of it would naturally be diverted in the direction of lower resistance, *i e*, up the internal iliac and around the corner down into the external iliac and through the aneurismal sac

It would appear from the facts presented that the internal iliac artery* occupies a unique and strategic position in the circulatory system of the lower extremity, for under certain conditions blood may flow along it in either direction If the external iliac alone is blocked, blood flows along the internal iliac distally into the inferior gluteal, and so into the crucial anastomosis If the common iliac alone is blocked, blood flows through the internal iliac proximally into the external iliac and so down the femoral It is a most convenient cut-off through which the stream of blood can flow now upwards and now downwards, as necessity requires Still it is not indispensable It can be tied without any serious disturbance to the circulation in the parts of the body to which it is distributed, and without danger to the life of the lower limb But if during the process of tying the main trunk, its branches are also blocked, the direct flow of blood from the ilio-lumbar and lateral sacral above into the gluteal below will be arrested and the direct chain of anastomoses into lower

* In early embryonic life it is a most important artery because the primitive inferior gluteal arises from it and forms the earliest known artery of the lower limb Thus is later on converted into the inferior gluteal and popliteal arteries of the adult The external iliac and femoral are later developments, and as they increase in importance the primitive gluteal dwindles considerably

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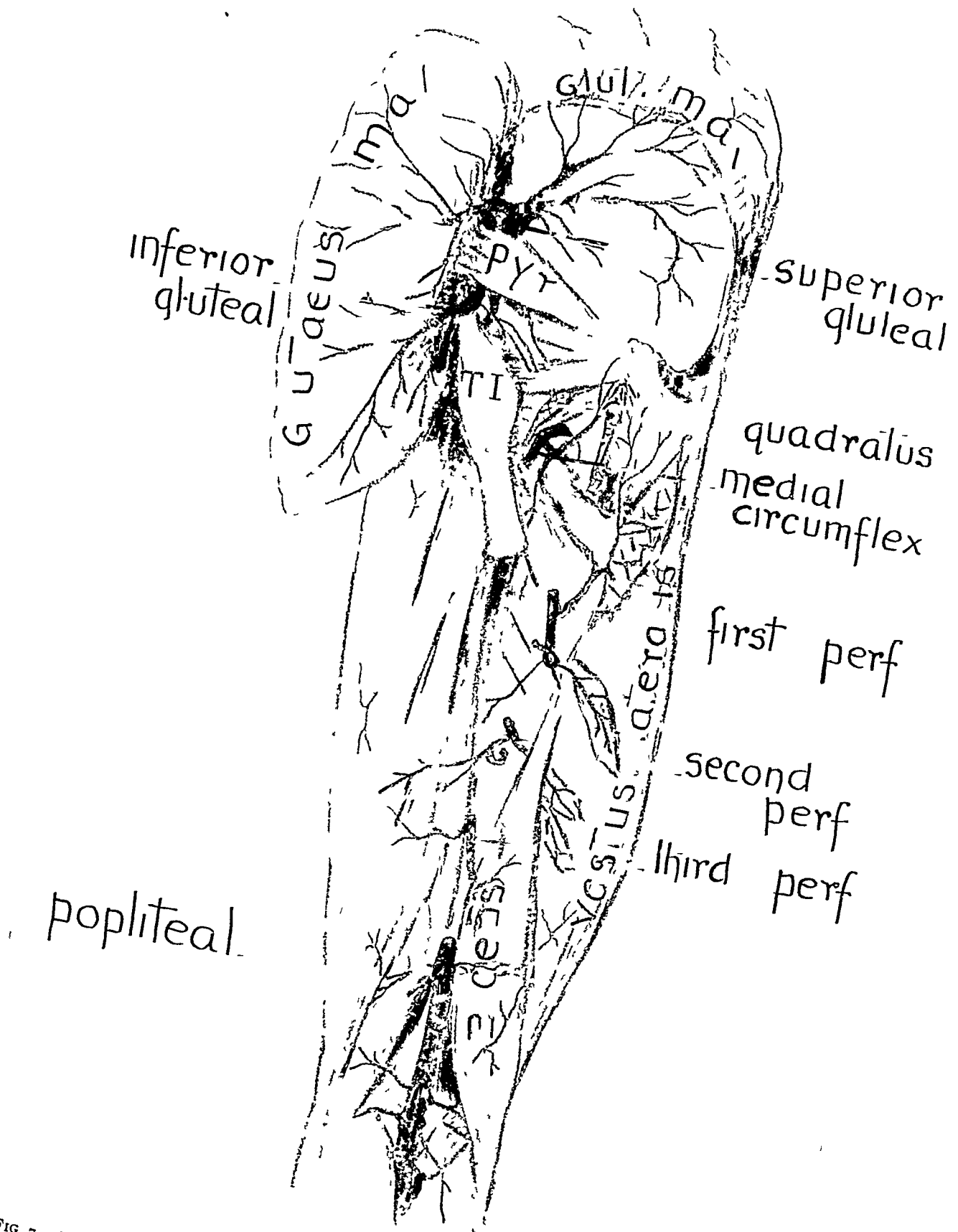


FIG 7 —From Cunningham, shows the anastomotic chain between the superior and inferior gluteal and the branches of the medial and lateral circumflex (crucial anastomosis) and the perforating branches of the profunda femoris

limb will be broken. This will probably not be attended by any serious consequences if the direct flow from the common into the external iliac is still unobstructed. But if that channel is also blocked, gangrene can hardly be averted.

It seems reasonable to infer from the facts at our disposal that the surest way to cure an aneurism arising from the external iliac and encroaching on the bifurcation of the common is to tie both common and internal iliac arteries simultaneously. Direct flow through the aneurism would stop at once and could never be reestablished if the ligatures held fast. Therefore recurrent pulsation would be impossible. The danger of gangrene would perhaps be slightly increased, because the whole strain of the circulation would be thrown on the collateral channels by the immediate and complete blocking of the path through the sac. We have previously pointed out that defective collateral vessels will often dam the blood back into its original channel through the sac and produce recurrent pulsation. It is clear that if the cut-off or safety valve is obstructed that gangrene is sure to follow if the collateral circulation is defective.

The technical difficulties of ligature of the internal iliac artery are not great, if the artery is exposed by the intraperitoneal route. The artery is 37 mm ($1\frac{1}{2}$ inches) long. The ureter crosses it at its origin and runs distally along its anterior border. The internal iliac vein lies posterior to the artery. On its lateral side it is separated from the psoas muscle by the external iliac vein, and at a lower level from the side of the pelvis by a mass of fat through which the obturator nerve passes forwards. The pelvic colon lies in front of the medial side of the left artery. The easiest way to find the artery is to expose the bifurcation of the common iliac trunk and to follow the internal iliac downwards. The ureter will peel upwards with the peritoneum. Care should be taken to keep inside the arterial sheath and to avoid injuring the veins. The proximal portion of the artery should be tied so as to avoid any possibility of injuring any of its branches.

In Figs 3 and 4 we have presented a schematic picture of the aneurism described as accurately as we were able to visualize it at the time of the last operation. Figure 3 shows the aneurismal sac as it was when the distal ligature was placed around the femoral artery above the origin of the profunda. Figure 4 shows the same conditions with the anastomotic trunks through which blood flowed into the sac and down the thigh. The foregoing text will be greatly simplified by constant reference to these figures.

The rapid and complete cure following the operation was very gratifying, but not surprising, because it is now well known that once the dangers of primary hemorrhage are avoided, that the intrasaccular suture of aneurism (Matas) is less likely to be followed by complications than any other method of treatment. Recurrent pulsation cannot occur, gangrene is less frequent, impending gangrene is frequently averted, and œdema is usually relieved. There are two main reasons for the satisfactory results of the operation.

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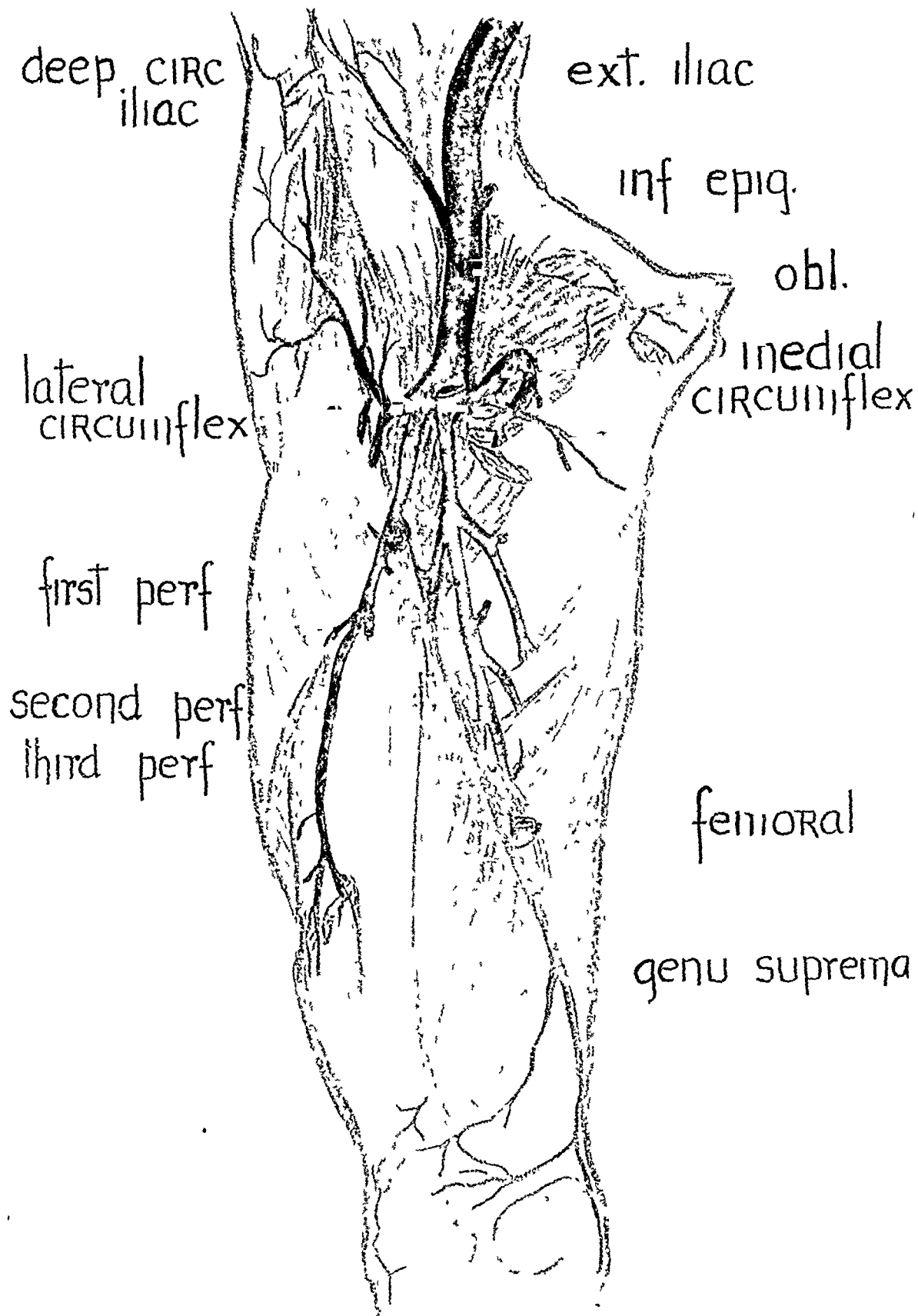


FIG 8 —From Cunningham, shows the proximal portion of the femoral artery and the termination of external iliac. The distal portion of the femoral has been removed. The profunda femoris and its branches are shown. Part only of the medial circumflex is seen. The whole course of the lateral circumflex is exposed.

Firstly, evacuation of the clots from the sac relieves the surrounding tissues from pressure. This allows the collateral arteries to open up to their full capacity and often relieves impending gangrene. It also allows the companion

veins to expand and œdema is similarly relieved. Both these results are seen with surprising rapidity after evacuation of the clots from a popliteal aneurism. *Secondly*, the suture of the arteries opening into the sac is done from within, consequently the walls of the sac are not disturbed, and collateral channels cannot possibly be injured. Further, and I believe this is the most important reason of all, any vital trunk, such as the profunda femoris or internal iliac, is closed by suture at its mouth, and the arterial stem and its branches are not endangered. This constitutes the main difference between the Matas operation and the operation of Antyllus. In the original Antyllus operation, the arteries entering the sac were secured by careful dissection before the sac was opened. This of course endangered the collateral circulation.

The essential safeguard of the Antyllian operation is hemostatic control. Where this is impossible, the procedure is unsurgical and is rarely justifiable. It is true that Syme, with unusual courage, broke the rule. He boldly opened aneurisms of the gluteal, axillary and carotid, trusting to his sense of touch to block up the bleeding artery with his forefinger while he secured the vessel with a ligature. But Syme was a genius, and, we may say, very fortunate to avoid disaster. Other surgeons, after incising the sac, have used the pack as a last resort when bleeding could not be arrested. Lately Edward B. Anderson, of Chattanooga, reported two cases, one of iliac and one subclavian aneurism, in which he succeeded in stopping bleeding by the pack. Still in spite of these successes, it would be very unwise to resort to such hazardous procedures. Rather, do we contend, that the Antyllian rule, making control of the circulation imperative, is just as binding now as when it was written. *Absolute control of the circulation through the iliac arteries ought to be possible if the abdominal aorta is compressed at a high level.* If pressure is applied above the origin of the lumbar arteries, which would then be cut out of the anastomotic field, no blood could possibly reach the interior of the sac through the iliac arteries. The sac could be inspected without hindrance and the openings of the vessels sutured. It is, however, very unlikely that modern surgical opinion will indorse a suggestion to treat iliac aneurisms by the open method as a primary procedure. A large proportion of the ilio-femoral aneurisms and a fair but smaller number of aneurisms occupying the common iliac and its branches are cured by proximal ligation of the external or common iliac, operations which are comparatively easy to perform and not dangerous to life. Therefore it is only fair to give safer methods a trial and only to resort to the more difficult and hazardous procedure in the event of failure.

While reviewing the literature bearing on the operative treatment of aneurisms of the iliac artery, I received a long personal letter from Dr. Rudolph Matas in which he most generously placed at my disposal the list of cases that have been treated by the intrasaccular method of suture which we owe to his genius. So far, I have been unable to find either from

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my own search or from the list collected by Matas a single case where an aneurism of the common iliac artery has been opened deliberately with the intent to close either by ligature (Syme-Antyllus), or by suture (Matas), the arterial trunks opening into it. The difficulties met with in controlling the arterial circulation and the terrifying possibilities of being unable to obliterate the opening into the sac are formidable enough to deter any surgeon who is not possessed of unusual courage and skill from attempting such a hazardous operation. In our case we were fighting for the patient's life with our backs to the wall. We had no other alternative except packing the sac with gauze, which I have always looked upon as a very unsatisfactory method of arresting arterial hemorrhage. Our consternation when we found that compression of the abdominal aorta did not control the bleeding, was complete. As long as I live I shall never forget the anxious minutes that followed until the internal iliac trunk was safely secured, and the bleeding was controlled. In Halsted's monograph on "Ligature of the Common Iliac Artery," he reports two cases which resemble in some respects my own case and which demonstrates emphatically the unusual dangers of opening the sacs of aneurisms of the iliac arteries. The following abstracts bring out the essential facts.

CASE XVIII—(Group II) KORTE *Ligation of the right common iliac artery for ruptured aneurism of the internal iliac. Consecutive ligation of the abdominal aorta. Death.* The case was one of a ruptured aneurism of the right external iliac artery in which the hæmatoma extended upwards retroperitoneally as high as the lower margin of the thorax and filled completely the flank and loins. The right common iliac was ligated by the intraperitoneal route. Pulsation and bruit ceased in the aneurism, but the large hæmatoma in the right side did not become smaller and continued to cause distress. Thirty-seven days after the first operation, a second one was undertaken. An incision was made into the hæmatoma. Large clots of blood were forced out under great pressure and profuse arterial bleeding followed. The cavity was packed and by the transperitoneal route the aorta was ligated over a pad of gauze. Bleeding ceased and the sac was opened wide and its contents evacuated. Slight bleeding was found coming from an opening in the interior of the sac (probably the mouth of the internal iliac artery) at the right edge of the true pelvis, which was controlled by pressure. The abdominal aorta was then tied permanently and the wounds sutured. The patient died an hour after the operation. At the autopsy other aneurisms were found in the thoracic aorta, right femoral and right profunda femoris arteries.

CASE XXIII—(Group I) TRENDLENBURG, FRIEDRICH *Ligation of the left common iliac artery for aneurisma dissecans of this vessel. Death.* An exploratory laparotomy was made for an obscure abdominal tumor in the region of the descending colon. A large retroperitoneal hæmatoma was found. This was opened and the coagula were removed. Suddenly profuse arterial bleeding occurred from a large pulsating aneurism situated in the region of the left common iliac artery. Under compression the rent in the aneurism became larger. It was then opened and a tremendous hemorrhage occurred. A ligature was applied to its root near the aorta. Hemorrhage from the distal side was controlled by a clamp and by tying off the rent with a strip of gauze. The patient died in three hours.

REFERENCES

- Anderson, Edward B Southern Medical Journal, vol xiii, p 589, 1920
Callendar, Curle Study of Arteriovenous Fistula ANNALS OF SURGERY, April, 1920
Holman, Emil The Physiology of an Arteriovenous Fistula Archives of Surgery,
July, 1923
Halsted W S The Effect of Ligation of the Common Iliac Artery on the Cir-
culation and Function of the Lower Extremity Transactions American Surgical
Assn, vol xxx, 1912
Matas, Rudolph Cure des anevrismes arteriels et arterio veineux par la suture intra-
sacculaire La Presse Medicale, Fervis 3, 1923
Ibid Arteriovenous Fistula of the Femoral Vessels, etc , Surgical Clinics of North Amer-
ica, Oct , 1922

COMBINED EXTIRPATION AND OBLITERATION IN THE TREATMENT OF VARICOSE VEINS*

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THE problem of varicose veins has always been a very important one to the medical officers of the Army, since the soldier must, from the very nature of his occupation, carry a heavy pack upon his shoulders and be on his feet constantly during drills or long marches, with the result that he is therefore very prone to develop such a condition. While the manifestations of this condition can be treated by palliative measures with a fair degree of success in the civilian population, so that their daily routine can be carried on with little or no inconvenience to themselves, it is not so with the soldier who is frequently called upon to make long marches and undergo physical hardships which of necessity demand that he be sound in body and mind.

Early in his military career, the author was confronted with this very perplexing problem, and after using all the classical operations then in vogue for the radical cure of this condition with indifferent success in the soldier, he looked for a better method.

After a long series of experiments on the cadaver, he conceived the idea of removing the offending veins by tying them at the saphenous opening as in the Trendelenberg operation and then lower down in the course of the same vein making a transverse incision and introducing a silver wire loop up through this opening and along the dilated lumen, tying the upper end of the vein to this loop, and by gentle traction downwards, removing the vein by inverting the vessel upon itself and repeating this process wherever the tortuosity of the vessels does not prevent the manipulation, as shown in Fig. 3, Plate B.

This operation was first tried out in 1901, and the results of it published in the *New York Medical Journal* and the *Philadelphia Medical Journal* for August 19, 1905, but was later superseded in the opinion of many operators by the well-known Mayo stripper operation, published in the *Surgery, Gynecology and Obstetrics* for April, 1906.

The operation then advocated by the writer proved eminently satisfactory on those veins, having a relatively straight course, such as the internal saphenous, but the tortuousness of the anastomosing veins about the popliteal space and in the calf of the leg frequently presented difficulties which permitted only short sections of the vein to be removed at a time and thus nullified in a measure the value of the operation except for the non-tortuous type of vein.

The presence of linear scars on the soldier's body, especially if they follow

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operation in the service, is objectionable for many reasons. First, to the conscientious man they may occasionally prove a source of irritation from wearing the legging or be painful by the incorporation of some of the cutaneous nerves within the scar tissue, or secondary, by interference with the full freedom of locomotion as the result of adhesions between the cutaneous tissues and the underlying muscle planes. Third, the reprehensible art of

malingering has numerous followers in the Army as well as outside, and the malingerer constantly points to these scars and presents a series of lame apologies for his inability to do full military duty, hoping eventually to secure his discharge through disability, as he did successfully in the days when the old linear incisions were used to expose the veins for excision. During the late war the linear incision method was resurrected and used by some surgeons on unsuitable cases as those showing marked pigmentation and beginning ulceration common at the point of greatest blood stagnation, with the result that there are many men with painful scars that break down

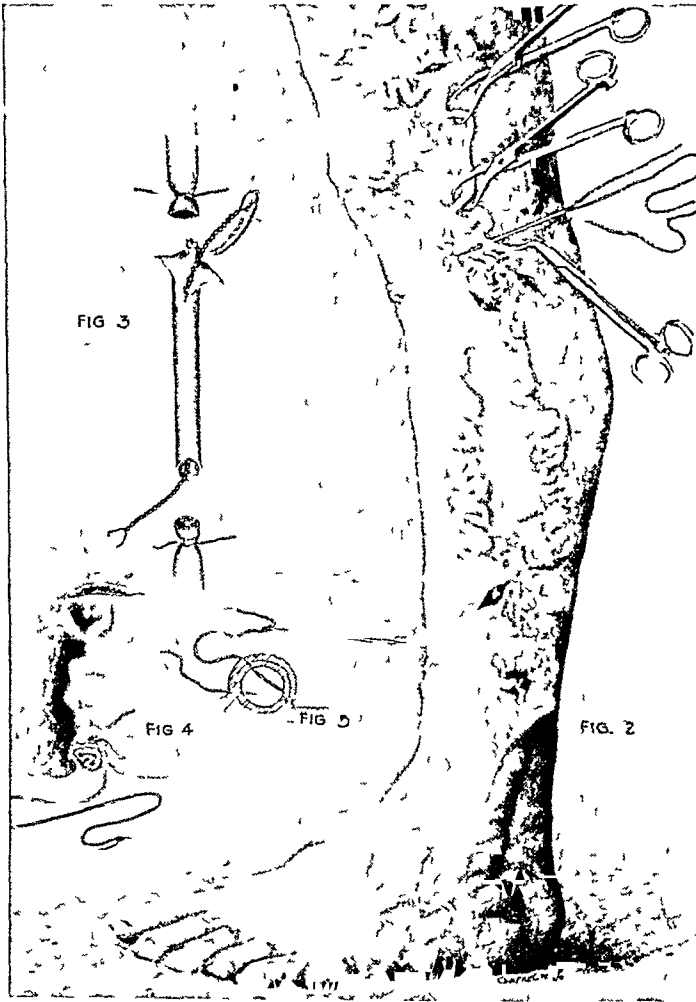


PLATE I — Showing the different steps in the operation

from the slightest trauma drawing compensation from the Government and who will continue to do so for the rest of their days (Plate III, Fig. 1)

Confronted thus with these difficulties, the author, with precaution necessary to insure safety, set about to devise some method of procedure which would give a more hopeful aspect to the situation and effect a cure, without leaving the patient with a series of these linear scars, which, at least, are unsightly, if not incapacitating.

It is the opinion of the writer that the removal of the tortuous vein plays but a small part in the cure of the disability incident to the general varicosity. It is believed that the essential feature is the complete obliteration of the lumen of the vein and all its connections with the deep circulation. If this is suc-

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cessfully accomplished, it is questionable whether or not it is necessary to remove the varicose vessel itself. As a preparatory measure the night preceding operation, the limb is shaved and the varicose veins are made more prominent by a circular bandage below the saphenous opening, and they are outlined with a five per cent alcoholic solution of brilliant green while the patient is in a standing position.

The technic of the first step of the operation consists in the removal of the internal saphenous and other non-tortuous veins by the inversion method which was described in 1905, as shown in Plate I, Fig 3.

In the second step of the operation, a continuous suture of strong braided silk, number one or two, is used, and the essential feature of the operation is in the manner of its application with a heavy straight triangular cutting needle. The veins to be obliterated are blocked out between the proximal and distal incisions as shown in Fig 2, Plate I, six to ten inches apart and divided between ligatures. The

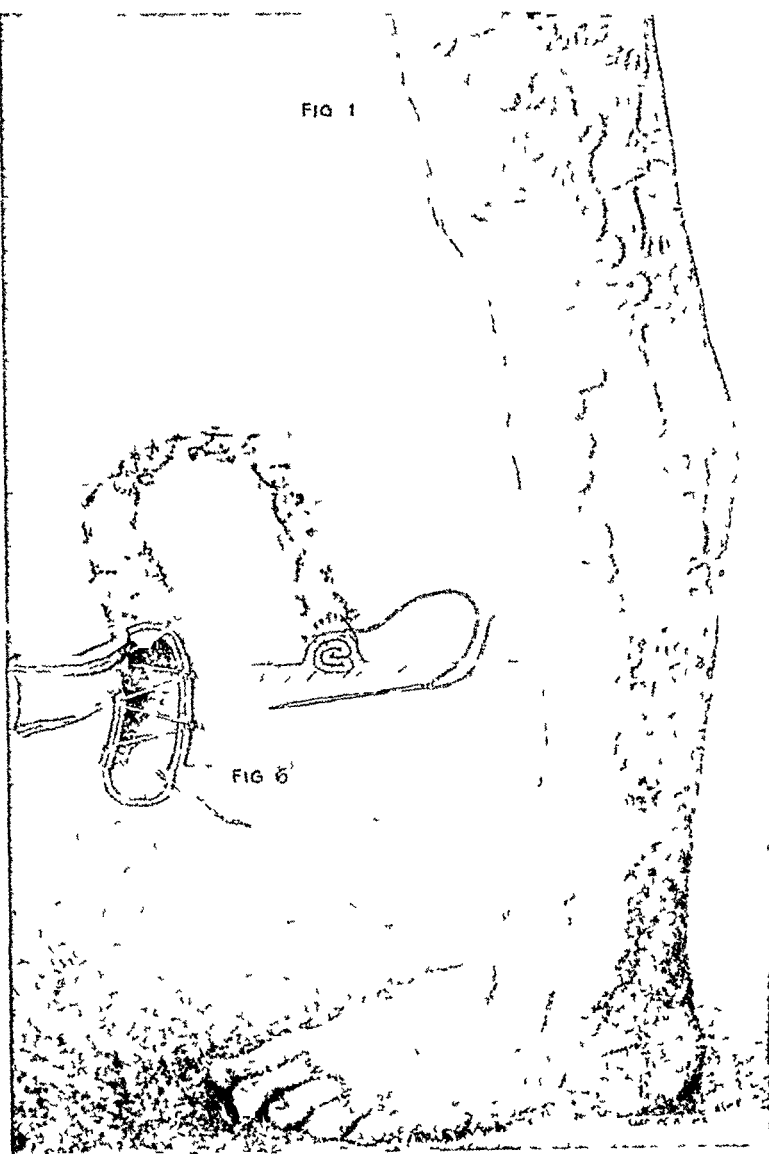


PLATE II — Figure 1 showing tortuous veins suitable for this method. Figure 6 showing subcutaneous application of suture.

vein is made more accessible for suture by elevation with towel clamps which encircle it as shown in Plate I, Fig 2. The needle is first passed under the vein and out on the opposite side, reintroduced at the point of exit and passed in front of the vein subcutaneously to the starting point, where it again emerges and thus encircles the vein and is tied as shown in Plate I, Fig 6. From this point the suture is continuous and is first passed through the posterior third of the vein, the needle is reintroduced at the point of exit and passed through the anterior third of the vein and thus continued for four or five inches, when the needle is again passed completely around the vein, as done in the first step and the free end of the suture is pulled through the needle far enough to permit the suture to encircle

the vein doubled and the long end of the suture encircling the vein is tied and cut, which permits the original suture to be continued to the end of the section where it is tied after encircling the vein. The small incisions used are closed by accurate interrupted sutures. Care is taken to include in this continuous suture all small lateral branches entering the main vessel. Such an application effects not only a complete collapse of the vessel walls, but the



PLATE III—1 Healed ulcer in upper end of linear scar that persisted for two years. 2 Usual appearance of limb after removal of subcutaneous sutures. 3 Tortuosity shown here and in Fig. 1 especially suitable for this method.

injury done to the intima of the vessel by the puncturing needle and the resulting pressure from the ligature has sufficient thrombo-genetic action to insure almost entire obliteration of the dilated lumen as shown in Plate III. All sutures removed on tenth day.

The following is the pathologist's report: One mass of the young connective tissue replacing the lumen shows its cells widely separated and its lymph-spaces dilated, probably due to mechanical cedema. One cross-section of a medium-sized vein shows approximately one-tenth of the lumen remaining partly lined by thickened epithelium. There is a connective-tissue trabecula separating this portion of the lumen from

the remainder which has been filled with young connective tissue. One area of this connective tissue is markedly cedematous. A section of a larger vessel shows complete obliteration of the lumen, atrophy and round-cell infiltration of involuntary muscle. The organization of this large vein has been accomplished by the formation of numerous formed blood-vessels. (Section removed six weeks after operation for pathological examination.)

Of course a nicety of the operation consists in the amount of tension to be applied to the suture so as not to produce cedema of the skin over the course of the suture and as a further precaution against this condition, the skin at intervals along the course of the suture is slightly scarified.

Proper marking of the vein to outline its tortuosity is imperative as it is

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absolutely essential that the vein is properly elevated with the towel clamp to insure transfixion with the needle if success is to be assured. If no dye is available, the proper application of the towel clamp may be facilitated by the temporary use of a tourniquet to make the vessels prominent.

In some instances there persisted along the course of the occluded veins a suggestion of a ridge as shown in accompanying photograph of one of the completed cases, but on exploration this proved to be the collapsed vein plus considerable fibrous tissue.

This method is not conducive to rapid operating as it consumes more time than either the open or the subcutaneous method of extirpation, but the final result is more satisfactory.

The advantages of the method just described are

- 1 Its simplicity
- 2 The obliteration of the vessel lumen
- 3 The absence of scarring following operation
- 4 The ligation of both proximal and distal ends preclude the possibility of recurrence *per se* provided all collateral branches are included in the sutures

5 The absence of painful subcutaneous areas that frequently follow the application of the time-honored independent or interrupted subcutaneous sutures which permits of an accumulation of blood between each adjoining suture. This accumulation may occasionally become infected, and if so, lead to other complications.

6 It is applicable where other methods are not, and it is immaterial if limited pathological changes exist within the vessels themselves rendering them friable or brittle, or if marked tortuousness precludes the successful use of other methods.



PLATE IV —Longitudinal section of a medium size vein showing the partially obliterated lumen to be markedly irregular in linear aspect

In view of these facts, it is believed that there is presented here a method which offers a promising beginning along simple lines in the treatment of varicose veins, and the results have proven universally satisfactory

The illustrations accompanying this article are self-explanatory

Of the thirty-three cases operated by this method, 15 1 per cent have been operated over two years, 39 4 per cent have been operated over one year, and 45 5 per cent have been done less than a year, and the results have been satisfactory in all cases

VALUE OF PRELIMINARY CIRCULAR CONSTRICTION BY RUBBER TUBE IN CERTAIN CASES REQUIRING AMPUTATION⁺

BY ROBERT EMMETT FARR, M D.

OF MINNEAPOLIS, MINN

AN emergency in which amputation of the arm seemed absolutely necessary and in which the condition of the patient was such that, in the writer's judgment, a fatal issue would inevitably follow amputation, was the occasion for utilizing a rubber elastic tube Its use was so simple and it answered

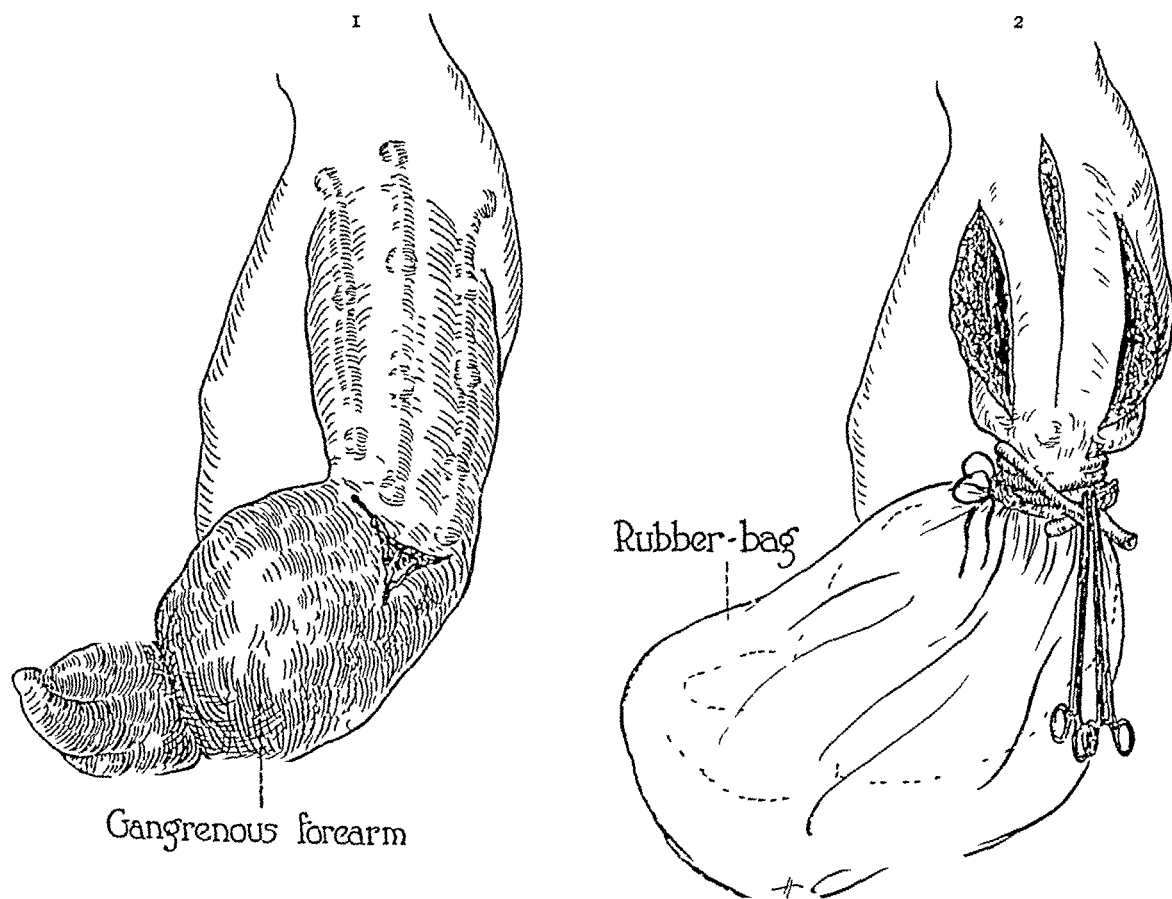


FIG 1—Case I Gas distended arm Lines of infiltration with novocain solution
FIG 2—Case I Showing multiple incisions of the arm and exclusion by means of
tourniquet of gangrenous forearm

the purpose so admirably in fact as no other method, in our opinion, would have done that we think it worth while to suggest its use in similar cases as well as in a variety of other conditions

CASE I—Robert N, age sixteen, had the misfortune of having his left arm run over by a truck on March 19, 1923 Two days later he was seen by Dr E S Geist, who kindly referred him to me for treatment When examined, the boy, who had had an extensive hemorrhage at the time of the accident, was in a precarious general condition His hæmoglobin was 28 per cent, Dare method, his temperature was 102, his pulse 120,

* Presented before the Minnesota Academy of Medicine, February 13, 1924

and the wound showed gas-forming bacilli. Any extensive operative procedure seemed entirely unjustified. He was given large amounts of normal saline, but transfusion was withheld on account of fear of anaphylaxis. Locally, the boy's arm was gangrenous to a point just above the elbow and the forearm was greatly distended with gas. From the elbow to a point extending well above the shoulder the skin was reddened, alive, and the tissues were greatly swollen and distended with gas (Fig 1).

Treatment—Under local infiltration anæsthesia, multiple incisions were made longitudinally along the arm extending above the shoulder and upon the chest and back (Fig 2). The subcutaneous tissue, although distended with gas, presented no necrosis above the elbow. Amputation just above the elbow seemed absolutely necessary, but the precarious condition of the boy seemed to contra-indicate this, while it was necessary to eliminate this greatly enlarged gangrenous member from the patient's economy. Accordingly a new piece of rubber tubing one-half inch in diameter was wrapped tightly around the arm at the line of demarcation and securely anchored in place (Fig 2). This procedure effectually eliminated the possibility of absorption from below this point. The application of the tube did not in the slightest degree reduce the boy's resistance which was already at the lowest ebb. The gangrenous arm was wrapped in strong formalin gauze and securely sealed by a rubber envelope. The boy was returned to bed without any appreciable change in his general condition. The skin was protected by rubber cement and the wound Dakinized. In twenty-four hours his pulse was 110, his temperature dropped to 100, and although the inroads of the bacillus aerogenus had been arrested, his condition was extremely bad and death seemed imminent. We therefore ventured to give him 100 c.c. of blood by direct method, using his mother, whose blood matched with his, as donor. A marked anaphylactic reaction followed, notwithstanding which the boy made a slow but uneventful recovery.

On April 4, 1923, fourteen days later, amputation at the junction of the upper and middle third was completed under brachial anæsthesia without removing the patient from bed.

CASE II—Mr L. J., age nineteen, was seen in consultation with Dr S. R. Maxeiner, to whom I am indebted for the privilege of its inclusion in this report. He was injured on May 17, 1923, by a circular saw, which cut a deep gash in the axilla. The great pectoral, serratus and latissimus muscles were partially divided, the patient escaping injury to the axillary vessels and nerves. He was seen, after first aid has been rendered, by Dr H. C. Anderson, who partially closed the wound with adequate drainage. The patient was then referred to Doctor Maxeiner at St. Mary's Hospital, where I saw him in consultation on May 19, 1923. Under gas anæsthesia multiple incisions over the wall of the chest were made both anteriorly and posteriorly. A thorough debridement of all discolored and non-reacting muscle was made. Skin flaps were dissected up to the line where it was estimated future amputation would be necessary and at my suggestion the rubber constrictor applied just beneath the origin of the flaps. In this instance, Doctor Maxeiner suggested making several turns of the rubber tube which I believe is of decided advantage in the procedure as it was found at the time of the completion of the amputation on May 24, 1923, that the muscles, arteries and nerves had been completely and cleanly divided down to the bone. The surfaces of the soft tissues presented a clean granular appearance and it was only necessary to divide the humerus, inject the nerves with alcohol and suture the flaps in place. This patient, like Case I, has made an uneventful recovery.

CASE III—Mrs S. K. was admitted to the hospital on June 6, 1923, and seen in consultation with Dr George Gordon. History: Age, fifty-seven. Jewess. Patient began having pain in left great toe five weeks before admission. This gradually became more severe and discoloration was noted a week before admission. Her past history is negative except for cardiac trouble first noted about two months ago, and at this time there was developed speech defect, a drooping right eyelid and blindness in this eye and

PRELIMINARY CIRCULAR CONSTRICTION IN AMPUTATION

a mask-like expression When seen in consultation the findings were blindness in the right eye, complete irregularity of cardiac rhythm with an apical rate of 180 and radial 140 Moist râles were present in the bases of both lungs The left great toe showed gangrene with bluish discoloration and there was evidence of poor blood supply over the lower portion of the shin Digitalis was crowded two days On June 8, 1923, under local infiltration and sciatic block an attempt was made to do a left femoral periarterial sympathectomy However, upon dissecting away the outer coat of the artery it was found that the lumen was completely closed by the processes of endarteritis obliterans It was therefore decided that amputation would be required The sciatic nerve was identified, severed and blocked with alcohol It was thought advisable not to proceed further with the operation at this time The patient was returned to bed Fluids were forced by hypodermoclysis and digitalis was continued during the next five days On June 13, 1923, her pulse was 140 Subdermal infiltration with novocain was made The skin was dissected from both anterior and posterior surfaces of thigh and turned upward Beneath the skin flaps the rubber tourniquet was applied tightly without further manipu-

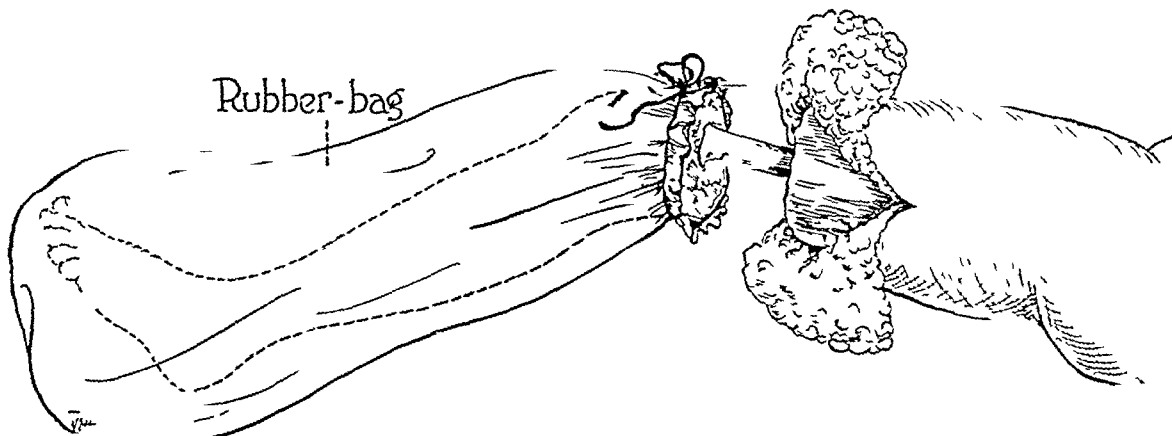


FIG 3—Case III Amputation of soft tissues resulting from application of tourniquet

lation and the patient was returned to bed Five days later without removal from bed the amputation was completed, the only requirement being a small amount of novocain in the muscle tissue proximal to the tourniquet (Fig 3) The femoral nerve which had not been identified previously was identified and blocked with alcohol The femur was divided without pain Dakin's tubes were inserted and the skin flaps closed loosely At this time pulse of patient did not go above 120 There was practically no hemorrhage The next day the white blood count was 15,000 and hæmoglobin taken at this time was 38 per cent During the next five days there was slight sloughing of the skin flaps which were unnecessarily long and the wound remained clean with Dakinization However, on the twenty-fourth, sixteen days after the primary operation, while being changed in position by the nurse she suddenly collapsed Pulse became very rapid and irregular Temperature rose to 102 She became unconscious and did not regain consciousness The left arm became limp and the patient died on June 25th An autopsy could not be secured In the writer's opinion this patient could not have survived the amputation by the classical method even under local anæsthesia It was thought that death resulted from central thrombosis

Remarks The application of the rubber tube presents, it seems to me, a wide range of possibilities It gives one a shockless, painless, quickly executed method of dividing all the tissues of a limb excepting the bone It therefore presents all of the advantages of immediate amputation without its disadvantages The absence of pain was a striking feature of the convalescence in Cases I and II In Case III the patient was semi-delirious and

complained almost constantly as would have been the case under any form of treatment. While one sees reports from time to time that the nerves should not be constricted by ligatures, etc., because of resulting post-operative pain, it is well-known that marked constriction of a nerve is one of the time-honored and effective means of producing anæsthesia. The effect of this method upon the liability to secondary hemorrhage is more or less problematic. The analogous use of pressure upon the vessels in other fields of surgery would seem to indicate that secondary hemorrhage would be less liable to occur than when the orthodox method is employed. In these cases a rubber tourniquet was kept in readiness for this emergency, which however did not present

LACK OF OPERATIVE INDICATIONS IN ASTHMA AND OTHER FORMS OF ALLERGY

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THE value of statistics in this connection cannot be over-estimated. My impression always was that patients suffering from asthma and other forms of allergy, were operated upon too much, but I never realized to what extent until I had compiled the statistics herewith submitted. Of three hundred patients 30.4 per cent were operated upon. We must bear in mind that a good many of these patients were young children who have escaped the surgeon's knife thus far, only because they have not lived long enough. An even larger group of patients have thus far escaped operations because as yet the doctors have not succeeded in overcoming their fears or convincing them that they really will be benefited by operative procedure. I dare say before the life's cycle of these three hundred patients is over, the 30.4 per cent operated upon will be materially increased, by recruits gained from the last two groups. Yet not a single patient was cured by any of these operations. Sometimes the shock of an operation in these patients will so alter the autonomic nervous system which is really at the bottom of this disease,¹ that a temporary improvement will be obtained. The surgeon need not congratulate himself, however, that this particular operation was indicated, any other operation would have accomplished the same result. Even in these rare cases, I believe surgery is not indicated.

TABLE I

Total No of Cases . 300

Operations performed —

Appendectomy	17	Throat	33
Miscellaneous	29	Nose	28
Female generative organs	13	Angio-Neurotic-œdema	1
Total No anatomical operations	121, or 40%	Combined operations	17
Total No patients operated upon		104 or 30.4%	

As Table I indicates the operations anatomically only, and does not indicate when the patient was operated upon repeatedly in the same region, the actual number of operations performed is really much greater. One patient was operated upon the nose and sinuses thirteen times, and yet is listed as only one. The operations by the dentist on the mouth removal of teeth operations for pyorrhœa, etc., in an effort to cure asthma, these operations are not listed.

TABLE II

	Throat	Nose	Appendix	Female genitalia	Miscellaneous
Throat Operations	0	5	3	0	1
Nose	5	0	2	1	2
Appendix	2	1	0	3	0
Female Genitalia	0	1	3	0	0
Miscellaneous	1	2	0	0	0

Out of 104 patients, 17 had more than one kind of an anatomical operation. The above table shows this combination.

NOSE AND THROAT

Operations on the nose and throat, and sinuses seem to be by far the most popular operation in allergy, particularly in the manifestation of asthma, and hay-fever. Fifty-six patients or 18.7 per cent in our series of three hundred cases underwent these operations, a good many of them more than one time. One patient was operated upon thirteen times. In fact in this region multiple operations seem to be the rule rather than the exception. Patients told me repeatedly, that the reason they have not as yet consented to this fashionable operation, was because they knew that one operation meant more in the future. From my experience I believe they are right. When the patient is not relieved, as he is sure not to be, by the operation of the first surgeon, he tries another, who finds further indications for operations. The result is that the more surgeons they see the more operations they have. The popular operations in this region are particularly tonsillectomy, adenoidectomy, turbinatectomy, operations on septum, spurs, polyps, and sinuses.

I believe that the great majority of these patients belong to the group of status-thymo-lymphaticus and normally have an hypertrophy of all the lymphatic tissue and should be left alone. Very often the operations on the nose and throat in these patients take on a wholesale character, every member of the family is operated upon. The removal in these cases of hypertrophied tonsils does no good. It is surprising to see how the indications for operation in this region disappear² if you relieve or cure the asthma by means of allergic principle, *i e*, determine the allergin, eradicate it, if this is impossible, desensitize the patient. Only one patient was relieved of the asthma for a period of three years, a few for a few months, the rest not at all. Many patients gave a history that nose and throat operations aggravated their conditions.

I am very well acquainted with the theories that prompt surgeons to undertake operations in this region for the relief of asthma and hay-fever: removal of focus of infection, and reflex irritation, source of sensitization, increase breathing space, etc. Practically, however, this does not work out, because the patients are not benefited by these operations. As the result of my experience, I believe that operations on the nose and throat for the relief of any of the manifestations of allergy should be completely abandoned.

LACK OF OPERATIVE INDICATIONS IN ASTHMA

TABLE III

The number of operations performed on the three hundred patients by the time they reached certain ages

Age	No operations performed anatomically	Age	No operations performed anatomically
0 - 9 - 14		40 - 49 - 29	
10 - 19 - 10		50 - 59 - 5	
20 - 29 - 28		60 - 69 - 0	
30 - 39 - 21		Age unknown - 4	

120 Anatomic

Angioneurotic Œdema One patient was operated upon. An incision was made into the swelling which occurred at the side of the nose and beneath the eyes. When this recurred some time later at the same place, it was quickly relieved by adrenalin injections. I know of another case where a laparotomy for intestinal obstruction was performed for angioneurotic œdema of the small intestine. Angioneurotic œdema may occur not only anywhere on the surface of the body, but also in any of the hollow or solid ³ viscera.

Female Generative Organs Thirteen women out of 167 female patients had operations on the female generative organs. The operations were mainly for the various benign tumors which occur in the ovary and the uterus, cysts, fibroids, etc. The removal of these tumors, as well as the eradication of inflammations and infections existing in the cervix, tubes and pelvis, did not in the slightest degree favorably influence the asthmatic attacks of these patients. The characteristic feature of these patients was that their asthma was aggravated at the menstrual period. The operation was undertaken not only for the relief of the pathological condition existing in the pelvis, but also with the hope of favorably influencing the asthma. The rationale of the procedure was that the pathology in the pelvis reflexly produced the asthma. I have yet to see a single case of true bronchial asthma cured by any operation on the female genitalia. Operations on the female generative organs, for the cure of asthma, should be abandoned. Table IV shows the combination of the various manifestations of allergy as they occurred in our three hundred office patients.

TABLE IV

	No. of cases	Asthma	Hay fever	Allergy of the gastro- intestinal tract	Allergy of the skin
Asthma	237		56	49	59
Hay Fever	82	56		33	26
Allergy of the gastro- intestinal tract	95	49	33		59
Allergy of Skin	104	59	26	59	
Asthma alone	118				
Hay Fever alone	6				
Allergy G. I. tract alone	11				
Allergy skin alone	4				

Appendectomy Seventeen out of these three hundred cases (6 per cent) had appendectomy performed. Several times that number were repeatedly advised appendectomy but refused. In none of the cases was appendectomy undertaken with the idea of curing or relieving the asthma although Gutman⁴ claims that a chronic appendicitis may reflexly, by irritating the vagal terminations, give rise to attacks of asthma. To prove his point he presses over McBurney's point and elicits in these cases attacks of asthma. By appendectomy he cures his asthma. I could obtain no such results by the former method or in the latter cases. The reason why appendicitis is so frequently diagnosed in these allergic cases is due to the fact that no matter from what form of allergy the patient is suffering gastro-intestinal symptoms are a conspicuous manifestation. Ninety-five patients of our group showed definite allergic manifestations of the digestive tract. This consisted of abdominal pain, distention, sour eructations, belching, constipation or diarrhoea, nausea and vomiting. Tenderness in the right iliac fossæ is a very frequent occurrence in these cases. It is evident that these symptoms may be readily mistaken for appendicitis. The lack of abdominal rigidity and a definite history of allergy is a great help in excluding appendicitis. I have repeatedly, promptly eradicated all digestive disturbances of years' standing by merely determining by skin tests the noxious agent and eliminating the allergic food from the diet. Operations in these cases fail to relieve the gastro-intestinal symptoms.

The appendix is removed indiscriminately for a multiplicity of diverse conditions. A thorough study before operation would have saved these patients needless surgery. Any and all of the various manifestations of allergy is very frequently associated with indigestion and right-sided pain.

Miscellaneous Operations Twenty-nine (9.66 per cent) patients were operated upon for miscellaneous conditions. These consisted mainly of hernias, hemorrhoids, duodenal ulcers, tumors, abscesses, etc., these operations were not undertaken with the object of relieving the various manifestations of allergy. Two hundred and thirty-seven patients out of our series of three hundred cases had asthma. In a good many of our cases the continuous straining and coughing and the venous stasis which accompanies asthma was responsible for the hernia and hemorrhoids. I believe that this explains the rather high number of miscellaneous operations in this disease as compared to other chronic non-operative diseases. To my mind all these operations were perfectly legitimate and should have been performed.

CONCLUSIONS

(1) A large number (30.4 per cent) of asthma and other forms of allergic patients are operated upon. Most of these operations are needless and useless.

(2) Nose and throat operations are the ones most frequently performed. The benefit derived from these operations is negligible, and should be abandoned for the cure of asthma and hay-fever.

LACK OF OPERATIVE INDICATIONS IN ASTHMA

(3) Indigestion of allergic origin is frequently mistaken for appendicitis

(4) Patients who were operated upon the pelvic organs failed to derive a cure or the slightest benefit from their asthma or hay-fever

(5) As these patients were operated upon not by any one surgeon, or in any one hospital, but by surgeons and hospitals generally, the final results justify the conclusions that we have no operation up to date which will cure or even benefit asthma or hay-fever.

(6) It may be argued that these cases represent only the operative failures, those cured I do not see. This reasoning is fallacious since none of these operations render the patient immune from further sickness. I would have obtained from patients the definite history that operation eradicated asthma or hay-fever. Thus far I have obtained no such history.

BIBLIOGRAPHY

¹Lintz, Wm. Important Factors in Bronchial Asthma, *Annals of Clinical Medicine*, in press now

²Lintz, Wm. Bronchial Asthma, *New York Medical Journal*, in press now

³Peters, W. Angioneurotische Nierenblutung. *Deutsche Ztschr. f. Chirurgie*, 1923, vol. clxxxii, p. 273

⁴Gutman, R. A. *La Presse Medicale*, No. 7, January 24, 1923, p. 72

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting Held February 4, 1924

The President, DR JOHN H JOPSON, in the Chair

AN AUTOGENOUS CONTROL OF THE OPERATION OF SYMPATHECTOMY

DR HENRY P BROWN, JR, presented a man, forty-one years of age, who was admitted to Doctor LeConte's service at the Pennsylvania Hospital on February 14, 1922, complaining of constant pain in the left great toe which had been present for three or four months before admission. During the four weeks preceding admission there had been swelling of his foot. He was a well-nourished, well-developed man, showing no demonstrable pathological changes aside from the condition of his legs.

The pulsations in the femoral arteries were palpable below Poupart's ligament on each side. No pulsations could be felt in the popliteal, anterior or posterior tibials on either side. The toes of the left foot were of a dusky pinkish color, and pressure showed a slow filling of the capillaries. The discoloration was more marked in the great toe, and it was in this one that the pain was most severe. The change in color extended to the mid-metatarsal region. The toes of the right foot showed the same type of discoloration as on the left, but to a much less degree, and there was no pain on this side.

February 24, 1922, under nitrous oxide anæsthesia, Doctor LeConte performed a sympathectomy on the left common femoral artery without encountering any technical difficulties. The relief from pain in the toe followed almost immediately, and in the course of a week or ten days there was a decided improvement in the circulation of the foot, to such an extent that it appeared even better than the right one.

In view of the fact that such an improvement had followed sympathectomy, Doctor LeConte urged the patient to allow the right artery to be operated upon, but this permission was refused for reasons best known to the patient himself.

Upon his discharge, March 24, his condition was recorded as being very much improved on the left side, and unchanged on the right.

In January of 1923, ten months after leaving the hospital, he was readmitted, complaining of pain and discoloration in the right great toe, and examination showed that gangrene had already appeared in this toe and the others of the same foot were of a dusky pinkish-blue color. The left foot showed a moderate discoloration extending to the mid-metatarsal region, but not nearly as marked as on the right side, and it was free from pain. He said that the left foot, the side upon which he had been operated, had been free from pain ever since his operation. He was extremely anxious to have a sympathectomy done on the right side, but in view of the fact that gangrene had already appeared in the great toe on this side, Doctor LeConte did not entertain much hope of relieving his condition. It was decided to give him the benefit of the doubt, and accordingly a sympathectomy was performed on the right femoral artery, just below Poupart's ligament, January 27, 1923. On expos-

CERVICAL LYMPHADENITIS SIMULATING A TUMOR

ing the artery it was seen to be very sclerotic and the phenomena of contraction of the vessel after removal of its adventia, as mentioned by LeRiche, was easily demonstrated

The relief from pain was almost immediate, but it was not followed by the improvement of the circulation which had followed operation on the left side. The gangrene of the right toe progressed and a line of demarcation having formed, it was amputated without an anæsthetic March 6th. Pathological examination showed almost complete obliteration of the vessel and great thickening of the walls.

By March 12, six days after removing the great toe, the gangrenous process had involved the second and third toes, and amputation of the leg was advised. March 22 this was done, the leg being removed at the junction of the middle and lower thirds. The notes at the time of operation state that there was practically no bleeding. The patient had insisted upon saving as much of the leg as possible, hence its removal at the lower rather than the upper third. Pathological examination of the tibial vessels showed marked thickening of the intima, but no fibrosis or calcification. One isolated portion of the dorsalis pedis showed a lesion of the arterial wall in the form of a circumscribed area of necrosis, involving the intima and media. There was actual caseation in the periphery of this lesion and a diffuse collection of polymorphonuclears in its centre.

April 22, the notes state that the flaps were sloughing but the patient's morale was much improved. He had been having attacks of marked depression. The sloughing gradually subsided and the stump healed over with granulation tissue, till at present, February 4th, there is a small granulating area approximately one and a half by two centimetres in extent.

The progress of the left foot has been most interesting. Upon two or three occasions during his present stay in the hospital the discoloration has become quite marked, lasting over a period from one to two weeks. At one time after wearing a shoe which was slightly tight, it appeared as though the toes would become gangrenous. With rest in bed, however, and constant heat (electric light) to his foot, the condition greatly improved. At present he spends most of his time in a wheel chair and on crutches, and as you can see, the foot is in fairly good condition.

This is the first case to come under their observation in which they have had what might almost be called an autogenous control of the operation of sympathectomy. While they have not had a sufficiently large number of cases of sympathectomy at the Pennsylvania Hospital to warrant drawing any conclusions, yet they feel that this operation has been an important factor in the preservation, up to this time, of the left foot of this man. Whether the improvement will be permanent or not, at the present time they have no means of telling.

CERVICAL LYMPHADENITIS SIMULATING A TUMOR

DR ASTLEY P. C. ASHHURST presented a further report in the case of the patient who was shown at the meeting of the Academy, October 1, 1923 (ANNALS OF SURGERY, 1924, vol lxxix, p 133). This patient returned to the Episcopal Hospital in January, 1924, and a few indolent lymph-nodes adjacent to the scar of the operation on the left side of the neck were excised. Histological examination of these, and further examinations of the original specimen by Dr C. Y. White, failed to reveal any indication of malignancy, as suggested by Doctor Nassau in his discussion of this case. Doctor White

found merely chronic inflammatory tissue without evidence of any specific histological changes

PROSTHETIC APPLIANCE REPLACING ONE-HALF OF LOWER JAW

DR GEORGE M DORRANCE presented a man who after having been operated upon twice by the late Dr Francis T Stewart for multilocular cyst of



FIG 1 —Prosthetic appliance for replacing one-half of lower jaw

jaw, first operation, nine years ago, and second operation seven years ago, in both of which operations the cysts were excised by the intrabuccal route,



FIG 2 —Prosthetic appliance for replacing one-half of lower jaw

had developed recurrence one year ago Upon examination six months ago, practically all of the left half of the lower jaw was involved X-ray studies by Doctor Dassell confirmed the diagnosis Patient was operated upon several

MOBILIZATION OF ANKYLOSED JOINTS

months ago and brought before this Society. At that time the importance of leaving intact the genio-hyoid muscles on both sides was pointed out. This patient is now perfectly comfortable and is able to masticate his food, with appliance which Doctor Dorrance demonstrated (Figs 1 and 2). The principle of the apparatus is the old double incline plane.

MOBILIZATION OF ANKYLOSED JOINTS

DR W S BAER, of Baltimore (by invitation), addressed the Academy on the question of the production of motion in ankylosed joints, joints which are really ankylosed and where the fibrous tissue is so dense in amount that no motion is allowed and not joints which are only partially ankylosed and in which various methods may give good results. The subject narrows itself to one of arthroplasty. For arthroplasty at first many things were used as interposing substances between the joint surfaces so that the bone would not grow together again, both organic and inorganic substances were used and both living and dead material. Nowadays only three methods of producing arthroplasty are in use: interposition of fascial flap free transplant, interposition of fascia and fat transplanted with living pedicle attached to it, or by organic material.

The membrane which the speaker had used for reasons he had demonstrated is made up of pig's bladder, chromicized to remain *in situ* fifty or sixty days. It does not make any difference which material is used, the free fascia, the fascia and fat with the pedicle, or the membrane. The pathology is the same.

It is said that free fascia when transplanted dies and that fascia and fat with the pedicle dies, but pigs' bladders do not have to die. In the interposition it is a question of the production of connective-tissue cells, which after a while show no tendency to unite with the layer on the opposite side of the joint.

Arthroplasty was first done on a series of cases in which it was done in the hope of saving life. Consequently, these first were for ankylosis of the jaw, congenital, or produced from disease at an early period of life, where disuse of the joint occurred and where the child could not be properly nourished because it could not swallow. But now arthroplasty has been solved for practically all parts of the body unless it be the knee-joint and the small joints of the hands and feet.

The knee-joint offers a problem which is gradually, although not yet completely, solved. The intimate anatomical relation of the tendons of the small joints of the body makes it difficult for arthroplasty because the range of motion is small and the tendons are so close to the joint that one is apt to get adhesion between the tendons and the small joints. But in all such joints as the jaw, shoulder, elbow, ankle, and hip, arthroplasty has come to stay. It is a proper operation in which one can almost with certainty predict the result.

The speaker then reported the results obtained by him during a period of about 15 years, comprising about 250 cases of arthroplasty on various

joints of the body Being enthusiastic over the treatment, he had tried it on many tubercular cases which had failed, so that the result is not so good as if he would take only the last five or six years The general result however, has been good serviceable motion being obtained in 78 per cent of the cases operated on At one time he had trouble with the pig's bladder material because he had not learned to what extent chromic acid was evulsed from certain joints That membrane which he now uses lasts only fifty days, and he had rarely had evulsion since of the membrane He prefers to use the membrane because he thinks it is easier than the fascia also it is always put up and ready for use and is the same consistency throughout Sometimes when one removes fascia one has to take a larger piece than is needed in order not to interfere with some part of the anatomy, also a hernia in the fascia lata is not an unheard of thing

In his series there are 46 cases of true ankylosis of the jaw, with one failure and one death—a case he should not have tackled, a child with congenital synostosis clear down to the molar teeth Two other children died of the same thing The child only weighed 3 pounds, although a year old, and the operation failed In the other cases the result was perfectly satisfactory, whether single or double jaws The mode of operation was simply a small incision underneath the zygoma All one has to do is to be careful in the retraction not to pull too hard on the branches of the smaller nerves There was some temporary fascial paralysis in 18 per cent of the cases, but never a permanent paralysis The next thing is to divide down the masseter muscle in a longitudinal manner and expose the bone Make an incision in the periosteum and shove back on both sides, the operation being done subperiosteally, leaving the branches of the temporal muscle Sometimes the condyle and the coronoid process are both involved If the condyle alone is involved, take it off, but if both are involved, remove both pieces of bone, done subperiosteally, there is no danger of hemorrhage The membrane is drawn directly around in a purse-string fashion and the skin closed up and the operation is finished He never does two sides at one sitting and usually allows three weeks to elapse before doing the second stage

In simple cases of undershot jaw, the chin is deflected to one side The patients feed themselves In some cases will be noticed a slight paresis of the facial nerve on one side, showing the eye also more open than is normal

In one case arthritis had developed late in life At the age of eighteen following the infection of a tooth, it, the infection, went to the jaw and surrounding structures Sometimes people go through life with ankylosed jaws and when they go to have their teeth fixed, discover that the work can not be done because their mouths can not be opened He had operated on both jaws for arthritis deformans with the result that five years later the man had the same amount of motion which we secured by operation

In cases of ankylosis of the shoulder and elbow Three cases of ankylosis of the shoulder in his series had resulted in two successes In eight cases of ankylosis of the elbow there were 72 per cent with good motion, one

MOBILIZATION OF ANKYLOSED JOINTS

case had a double ankylosis of both elbows. This case was operated on by Doctor Bennett and himself, he doing one elbow and the reporter the other. Five weeks after the second operation, the man can come up to almost normal level in pronation and supination.

The difference between resection and arthroplasty is the greater stability, the greater power and the more normal action in the joint itself secured by arthroplasty. Of course one can get good strength from resection of the elbow and good results but always there is lateral motion and the result is not good cosmetically.

Ankylosis of the hip-joint is another question and in certain cases one will almost always be able to guarantee that normal function in the joint itself will be obtained. He would avoid interfering in tuberculous cases because only fifty per cent of cures had been obtained in tuberculosis of the hip, while in the other fifty per cent one probably lights up the tuberculosis again in doing arthroplasty.

He would not operate in cases of hip disease due to infectious arthritis. One is not sure in arthritis deformans that the disease is over.

The procedure advocated by the speaker is the incision from the anterior superior spine around the trochanter to the sacro-iliac notch. The trochanter is cut with a broad chisel. Sometimes it is hard to tell where the acetabulum begins and one has to guess at the point where the ileum stops because there is new bone. Sometimes one does the arthroplasty on the end of the bone and sometimes on the ileum itself. Generally, one finds some small line of cleavage, and can chisel in between it and the acetabular cavity itself. Then separate and dislocate the head of the bone fragments, and file off the head until it is perfectly smooth and having done that, cover the head with the membrane entirely and sew the membrane into the fibrous tissue along the lines of the trochanter, replace it in the fragment, turn it down near the shaft and close the wound perfectly with silver wire. He leaves it in for six, eight or nine weeks as the case may warrant. He puts the limb in extension on a Thomas splint. At the end of three weeks this is removed and the patient is allowed to walk at the end of another week. Massage and hydrotherapy then are used. There have been in the hip cases 32 patients with Neisserian infection with 90 per cent of cures, by that he meant flexion of 60 degrees was secured. These cases lend themselves very well to arthroplasty, but they should not be operated on until one year after the acute process is over.

Septic cases are much more difficult than those with gonorrhoeal infection. They very often have marked scar tissue. Treatment in these cases is difficult and the reason to his mind is the one which has not allowed him to go further in the knee-joint than he has up to the present. In the elbow cases, motion is the great thing, in the hip-joint, motion and stability are necessary, but in the knee-joint, stability must be had and also good motion. He divides the knee-joint cases into three groups: those with fibrous ankylosis between the patella and tibia and between the femur and tibia, those with bony ankylosis in one or the other, and those with complete bony ankylosis. In

the fibrous ankylosis one can usually procure fairly good joints. He had gotten motion in about 80 per cent of the knee-joints of this type. His own cases show only 22 per cent of good motion where complete bony ankylosis had occurred. The knee-joint question is not so much the solving of arthroplasty as it is the solving of the question of interference with the soft parts. In association with the operation of arthroplasty he had been lengthening the triceps muscle by suitable incision and in sewing up he did not bring the quadrilateral muscle up to where it was before, he also takes out all the scar tissue around the joint itself. If it is left, motion is interfered with.

In conclusion he said that arthroplasty of the shoulder, jaw, elbow and hip, is an operation that can be perfectly well offered to the public. Arthroplasty in the knee-joint is still in the state of solution but becoming better and better every day as one recognizes difficulties in the periarticular tissue. The small joints should not be subjected to arthroplasty.

DR ASTLEY P. C. ASHHURST said that he would not attempt to compare his results with Doctor Baer's, as he has had so many more cases. Excluding arthroplasties of the jaw, for every one of his own cases of arthroplasty Doctor Baer has done ten, 200 to 20. His own results had been as follows:

Arthroplasty	Total	Good	Bad	Per cent
Elbow	8	5	3	37.5
Hip	8	4	4	50
Knee	4	2	2	50
	—	—	—	—
	20	11 (55%)	9	(45%)

	Total	Good	Bad
Excision of elbow (ankylosis, etc.)	8	7 (87.5%)	1 (12.5%)

	Total	Good	Fair	Unknown
Reconstruction of hip (pathological dislocation)	12	10	1	1

In arthroplasty of the elbow, after doing a number with very good results, he had several in succession in whom ankylosis recurred, so that he had about given up this operation in favor of excision, in spite of the partiality he might be expected to feel for the method of operation described by himself in 1915. In arthroplasty of the hip, the four failures were all on the same patient (two operations on each hip), but the four good results, in patients carefully selected, were so satisfactory that he regards it as an excellent operation. He had done only four arthroplasties of the knee. Doctor Baer says in cases with bony ankylosis he secured good results in only 20 per cent of his patients. Doctor Ashhurst had had two good results and two bad.

The speaker then presented five patients who had undergone either arthroplasty of the elbow or hip, also lantern slides for the purpose of showing why excision of the elbow is as good as arthroplasty in most cases, and why reconstruction of the hip is more generally applicable than is arthroplasty. As Doctor Baer says, the *indications* for arthroplasty, in the case of any joint, are very limited, and therefore he must exclude a large number of patients who are entitled to relief at the surgeon's hands. No joint in which the normal

FRAGILITIS OSSIIUM

contours of the bone ends are lost is suitable for arthroplasty, whereas excision of the elbow and reconstruction of the hip will give very useful limbs even when the joint has been utterly disorganized and deformed. In the knee, where the results are so very uncertain, even in Doctor Baer's own experience, the decision to attempt arthroplasty is very difficult to make, even when the suitable case presents itself.

DR DEFOREST P WILLARD said that tuberculosis is distinctly a contraindication to an attempt at arthroplasty, although in certain cases one has to operate in spite of it. Any acute or subacute infection during the time of its occurrence, any joint with marked destruction of the bone or of the soft parts, offers a poor seat for arthroplasty. The ideal case is one in which the ankylosed process has remained very closely localized in the joint itself such as arthritis or traumatic or pathologic origin. Another side not brought out and one of distinct importance is the after-treatment. Arthroplasties do not get well of themselves. They need courage on the part of the patients and the doctors, they need massage to bring back musculature and exercise to prevent further ankylosis. I think more can be done with active exercise than by simple passive motion of the joint. If the patient assists the surgeon, the end result will be better than with passive motion. There is the question of partial recurrence of limitation of motion after four or six months' periods. Many cases have marked improvement during four to six months and then there is distinct return of limitation of motion, not to the degree before arthroplasty but a distinct cutting down of motion.

DR ROBERT H IVY said that most of the patients with ankylosis of the mandible that he had seen had been remarkably well nourished and stated that they could eat practically a normal diet. In operating for this condition he preferred the curved incision of Blair. Being largely within the hair-line it leaves less visible deformity, is less likely to injure facial nerve fibres to the occipito-frontalis and orbicularis palpebrarum, and affords easy access to a pedicled temporal fascia flap, if desired, to interpose between the cut bone surfaces.

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DR GEORGE W WAGONER read a paper on the above subject (Idiopathic Osteopsathyrosis), for which see *ANNALS OF SURGERY*, July, 1924.

TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

Stated Meeting Held February 13, 1924

The President, DR EUGENE H POOL, in the Chair

OPERATIVE STEPS IN REMOVAL OF ADVANCED CANCER OF STOMACH

DR WILLY MEYER presented a man, sixty-four years old, who had come under his care with a very far advanced cancer of the distal two-thirds of the stomach, causing a stricture of the pylorus. There had been pain shortly after the ingestion of food for the last four months, no vomiting, loss of weight, but good appetite and bowel function. Examination showed a palpable growth in the epigastrium. Analysis of stomach contents proved the presence of a carcinoma with food retention. The X-rays corroborated this finding large residue after six hours with the stomach palpably distended for several inches.

Operation was indicated on account of the continuous severe pain. Permission was obtained from the family to add an operation on the costal arch, should this become necessary in order to reach healthy parts. December 26, 1923, median incision. Stomach widely infiltrated, with multiple cancerous metastases in lesser and major omentum, liver, hepatic ligament and parietal peritoneum. Proximal third of stomach free of tumor, greatly distended, elastic. Gastro-enterostomy alone possible. On lifting omentum plus transverse colon, it is seen that the tumor has trespassed upon the transverse colon and its mesocolon. Only anterior gastro-enterostomy is feasible, but the pouch is away up under the ribs. Addition of transverse horizontal incision to the tip of the left eleventh rib, with raising of costal arch according to Marwedel, as described by Doctor Meyer in the *Ann. A. M. A.*, October 6, 1906, p. 1059. This gives splendid access. Careful gauze tamponade, as stomach seems filled to capacity in spite of prolonged pre-operative lavage. Small puncture with knife, exit of whitish, thick fluid in shape of a spurt. Suction unsuccessful, gradual mechanical emptying of stomach pouch, its wall appears brittle, more than one-half inch thick. Suture anastomosis out of question, use of Murphy button only chance. With some difficulty the anastomosis with a long loop is perfected in front of the transverse colon and a part of the jejunum is stitched over it by means of two mattress sutures, the entire field is then covered with omentum, closure.

First days of convalescence somewhat stormy on account of continuous vomiting, improved by repeated lavage, then uninterrupted recovery with total cessation of previous pains. Button dropped into stomach, as expected, it is there still to-day, seven weeks after the operation, as radiographs show. (Presented.)

A few points of interest stand out conspicuously in this case.

1. Even in far-advanced cases of carcinoma of the gastro-intestinal tract, in the presence of great suffering of the patient, the operation should not be a mere exploration and the abdomen closed without an attempt being made to bring help. He had seen patients of this type live for six to eight months and longer in comparative comfort before they died.

RESECTION OF THE UPPER RECTUM FOR OBSTRUCTING CARCINOMA

2 In order to give the surgeon a free hand, permission for an additional operation on the costal arch should be obtained.

3 The osteoplastic raising of the costal arch opens the vault of the diaphragm

4 Murphy's button alone can accomplish a successful anastomosis in an emergency as the one stated above. Its use was clearly indicated here. In anterior gastro-enterostomy it will probably drop into the stomach. However, it is not an absolutely unwelcome guest, the organ after a while gets used to its presence.

The patient is greatly improved and relieved of his former pain. His life will be prolonged and has ceased to be a burden and misery to him.

RESECTION OF THE UPPER RECTUM FOR OBSTRUCTING CARCINOMA

DR. WILLY MEYER presented a woman, thirty-five years of age, who was presented before the New York Surgical Society on March 2, 1922 (see *ANNALS OF SURGERY*, December, 1922, p. 795, where details can be found). At that time Doctor Brewer expressed the desire to see the patient presented again three years after operation. The time elapsed is now two years and nine months. The operation was done in May, 1921, the combined method being employed, without preliminary caecostomy, when a thorough clinical examination plus radiograph had shown the presence of a cauliflower-growth in the upper rectum. Left peri-rectal incision, ligation of anterior meso-rectal artery right beneath the giving-off of the left colonic artery, tumor, the size of a fist, was found at the bottom of Douglas' pouch, attached to the posterior wall of the uterus and left appendages. It was bluntly loosened and freed all around, sacral cavity entered, temporary gauze tamponade on either side of gut, layer closure of abdominal wound. Patient transferred into knee-elbow posture, long incision in middle line above anus, excision of coccyx and lowest portion of sacrum, bilateral ligation of median hemorrhoidal artery, gauze tampons, put in before, extracted from below; gut freed and pulled into wound with great ease, closure plus drainage of peritoneal cavity, aseptic resection, leaving a rectal stump of about four inches, with the sphincter muscles, gentle stretching of latter, excision of mucosa and invagination of inverted proximal end through this canal, careful stitching in place, dressing. Two and a half days later first change of dressing, closed, projecting stump gangrenous, as expected, a fascia necrosis following, extending above sphincters, gradual recovery. A long-persisting fistula has closed. To-day the patient is in perfect health and in full control of her sphincteric apparatus.

A second, similar, but more advanced case in a female, fifty-three years, was operated upon in the same manner in June, 1922, again without primary caecostomy. Here the left appendages were more extensively adherent, but general condition forbade simultaneous hysterectomy, a sacral anus was formed, malignant pelvic infiltration was overcome later by deep X-ray treatment. Patient is in good condition so far.

Examination of the tumor in both instances showed adenocarcinoma.

The observation of the two cases suggest

1 The wisdom of retaining the lower portion of the rectum wherever this can be done. If the distal end of the tumor is well above the anus, the lowest portion of the rectum may be saved, otherwise only the sphincteric apparatus, continuous active training of the latter during convalescence helps in strengthening continence.

2 It seems wise not to have the proximal stump project, nor to close it airtight, not even for twenty-four hours, because with the reduced nutrition

the subsequent distention favors acute gangrene. It seems advisable to amputate the gut in front of the anal ring after it has been carefully stitched in place.

3 To keep the patient in the lateral posture for the first days, in order to avoid pressure upon the intestine that was pulled down.

DR GEORGE E. BREWER said he was very much impressed with the case of cancer of the stomach on account of the great advance the disease had made before operation and the immense relief brought about by the operation. He had rarely seen such relief as that, but some years ago he had had a case in which the patient gained twenty pounds within seven or eight months. As to the rectal case, he had been anxious to see it because when it was first reported by Doctor Meyer it had been doubtful if the patient would be alive three years afterward, and Doctor Meyer was to be congratulated on the excellent result. These as a class were most unfortunate cases, and the speaker knew of none he dreaded operating on more. Out of 81 cases he had had only four that had gone over four years. The first one, operated on seven years ago was well to-day, one was well for six years, and one for four years, then developed metastasis in the fifth year and eventually died five years and four months after operation. All of the patients that recovered were under forty-one years of age.

DOCTOR MEYER, in closing the discussion, said he had done this raising of the costal arch three times and had seen the patients make an uneventful recovery. In a case like this one, the full exposure of the proximal portion of the stomach could be made in no other way because it was far beneath the ribs within the vault of the diaphragm. The raising of the arch is best done with the help of an additional transverse incision to the tip of the left eleventh rib. Between the transverse fascia plus peritoneum on the one side, and the rectus muscle on the other, the surgeon quickly and easily advances bluntly toward the costal arch. Branches of the internal mammary artery should be preserved if possible. Then a curved elevator is pushed around the broad seventh rib cartilage and the latter divided close to the sternum, outwardly the seventh to tenth cartilage is cut with the knife in front of the bony rib. The skin-muscle flap having been replaced downward, the surgeon's hand takes hold of the costal arch and pulls it up, when the divided portion will yield, sometimes with a peculiar grating noise, and good access can be had up to and posteriorly of the cardia. Others mobilize the costal arch by cutting across below the left twelfth rib well into the belly of the latissimus dorsi, dividing only soft parts. The raising of the costal arch should be practiced more frequently. It will allow radical work in cases seemingly inoperable at first. In this case this patient's life was not worth living, he had so much pain after every meal that he preferred not to eat. To-day he has no pain, enjoys his meals, in fact. Often the patient has a peculiar sensation while eating, evidently, when the button has dropped against the anastomotic opening. The patient then lies down for a moment or two after which he can continue his meal. The point of emphasis is that the surgeon

RESULT OF AN OPERATION FOR THENAR PARALYSIS OF THUMB

should not simply close the abdomen when exploratory incision has shown far-advanced carcinoma, and call the case inoperable, but should endeavor to bring about relief

The rectal case presented had a sinus alongside the sacrum for two years. She had it taken care of with tampons until at last the sinus closed. She is now perfectly well and has full control of her bowel movements

RESULT OF AN OPERATION FOR THENAR PARALYSIS OF THE THUMB (EXTENSOR-FLEXOR-FLEXOR-PLASTY)

DR H. H. M. LYLE presented a girl, ten years old, who at the age of two, while crossing to Scotland with her mother, was almost washed overboard. In saving her, the left arm was forcibly jerked. After this accident



FIG. 1.—Before operation. The left hand is underdeveloped, its thumb is much shorter than the right. The hand shows a characteristic flat palm with atrophy of the thenar and hyperthenar eminences and absence of the thenar creases. Note the helpless position of the thumb as it lies in the same plane as the other digits. Note the slight ulnar contracture tendency in the ring and little finger of the left hand.

her left hand appeared to be useless for grasping and holding objects and she carried her elbow in a flexed position. The Ship's Doctor said "It was a strain that the child would soon outgrow." Unfortunately the mother took pneumonia and died, so our subsequent history is a blank until the father returned from the war one year later. He found that the elbow disability had disappeared, but the hand was still useless. The father took the patient to a specialist, who said, "that time alone would heal the paralysis." That was seven years ago. There has been no improvement. No history of fever, acute illness or antero-polio-myelitis could be obtained.

On January 14, 1924, this patient was admitted to Doctor Lyle's service at St. Luke's Hospital for operation. On examination the left hand showed a marked atrophy of the thenar eminence, some of the hyperthenar eminence and slight atrophy of the dorsal interosseous spaces. The left hand is smaller

than the right, the left thumb is markedly smaller and shorter than the right. The palm of the hand is flat and the thumb lies in the same plane as the remaining digits. The thenar crease is absent (Fig 1). X-ray plates of the left hand show the thumb to be smaller and shorter than the right, the radius and ulna of the left to be one-fourth inch shorter than the right, the pisiform very small and underdeveloped. No evidence of old fractures or epiphyseal separations. No cervical ribs. Wassermann negative. The patient



FIG 2—Showing result seven weeks after operation. Note the adduction and the formation of the thenar creases and the restoration of the palmar hollow.

cannot pick up or hold objects due to the fact that she cannot adduct her thumb, she lacks the essential pincer action. No sensory or trophic disturbances. It appears to be a pure motor lesion of the ulnar nerve affecting adduction of the thumb.

The question naturally arises: was it the result of an unrecognized anteropoliomyelitis, a traumatic root lesion of the brachial plexus, or a local lesion of the deep palmar branch (motor) of the ulnar?

The loss of active opposition is a very serious disability as it interferes materially with the function of the whole hand. Sir Harold Stiles in his work on the "Treatment of Injuries of the Peripheral Spinal Nerves" (1922), p. 166, says: "No satisfactory transplant appears to have been devised to replace the intrinsic thumb muscles whose loss make the digit almost useless as it falls back in the line with the other fingers and is unable to be opposed to them for picking up objects." Stiles recommends, for this condition, Baldwin's operation which is an arthrodesis of the first carpo-metacarpal joint. Doctor Lyle has employed this method and although it gives a thumb capable of picking up light objects, the thumb lacks strength. In our hands better functional results have been obtained by Steindler's flexor-plasty (1918) and by Ney's tendon transplantation (1921). However, the resulting pincer action obtained by

these latter procedures has not always been as strong as desired. In an effort to improve this essential action, Doctor Lyle has tried to combine the advantages of the flexor-plasty by Steindler with the good points of Ney's operation.

The operation evolved consists of two steps (extensor-flexor-flexor-plasty): 1. The extensor-flexor-plasty. 2. The flexor-plasty.

1. An incision is made over the extensor brevis pollicis extending from its insertion to a point where this tendon emerges from the posterior annular ligament; the tendon of the extensor brevis pollicis is then divided at this level. An anterior incision exposing the flexor carpi radialis at the wrist is made. The subcutaneous tissue is tunnelled obliquely from the distal edge of the anterior annular ligament to the insertion of the extensor brevis pollicis and the cut end of the extensor brevis pollicis threaded through this tunnel, passed

CONDITION TWELVE YEARS AFTER REMOVAL OF CANCER

under the annular ligament and sutured to the tendon of the flexor carpi radialis above the annular ligament

2 Flexor-plasty A palmar lateral incision is made over the tendon sheath of the flexor longus pollicis exposing it from its insertion to a point just below the head of the first metacarpal The tendon sheath is opened and the tendon split longitudinally, the outer half is freed from its insertion and withdrawn from the sheath, the sheath is then closed over the internal half The external half is carried subcutaneously around the outer side of the base of the first phalanx and sutured This can be readily done as the previously performed incision for the exposure of the insertion of the extensor brevis pollicis gives an excellent exposure for the flexor anchorage The thumb is then placed in the functioning position and fixed in plaster Gentle active movement was begun on the twelfth day, all support removed on the twenty-first day

It is her left hand Note how quickly and deftly she picks up small pins from the polished table (Fig 2), and it is only thirty-one days since the plaster case was removed Test the snap and power possessed by the left thumb and compare it with the right This operation has yielded a splendid functioning thumb

CONDITION TWELVE YEARS AFTER REMOVAL OF CANCER OF STOMACH

DR GEORGE H SEMKEN presented a woman who came under observation on March 11, 1912, then aged fifty-one years She had had symptoms of gastric disturbance for many years, beginning within one-half to two hours after meals and continuing for about one-half to one hour These were epigastric pressure, slight eructation of gas or bitter fluid, and frequent nausea but no vomiting There were occasional attacks of a burning sensation in the epigastrium, not relieved by the ingestion of food, but pain was seldom noted Her appetite was described as ravenous, but despite this, there had been a progressive loss of weight and strength As additional symptoms, she had had occasional sharp sternal or precordial pain, and there had been two recent hæmoptyses one, about a tablespoonful of clotted blood three weeks previously, and the other, a grape-sized clot, one week previously Her father had died from cancer of the stomach at the age of forty-eight years, and one sister had an abdominal tumor, probably a uterine fibroma No other cases of cancer were known The previous history was negative The abdominal findings were practically negative, excepting that occasionally, a small, firm, rounded tumor could be palpated above and to the right of the umbilicus, but not definitely enough for conclusive observations As additional findings there were (1) a cyst in the isthmus of the thyroid gland, 2.5 cm in diameter, (2) a mitral regurgitant murmur, (3) a uterine fibroid approximately first-size, with smaller subperitoneal nodules, and (4) a possible tuberculous focus in the apex of the left lung [Her husband and her son had both died from tuberculosis]

The analysis of the gastric contents, made by Dr S Basch, gave the following data The fasting stomach yielded one-half ounce of brownish-yellow, alkaline fluid showing a few meat particles One hour after a test meal of a roll and a glass of water, five ounces of brownish-yellow gastric contents, showing a few blood streaks, was obtained The solids, quantity three ounces, were mushy and poorly digested Total acidity, 24 No free HCl and no lactic acid A few gross and microscopic meat fragments were noted Examination of the fæces showed no occult blood

The operation, done on March 18, 1912, consisted in a resection of about three-fourths to four-fifths of the stomach, with a portion of the duodenum, and the related lymphatics, following the technic of Billroth, number two. The abdomen was opened through a right, paramedian epigastric incision. There was no free fluid, and there were no adhesions. The liver contained no metastases. At the pylorus was a firm tumor about 4.0 to 5.0 cm in diameter, mainly involving the inner wall of the stomach, but extending through all the coats. Slightly enlarged lymph-nodes were noted along the greater curvature, but none were found along the lesser curvature. The pylorus was freely movable. The proposed lines of resection of the stomach and duodenum were marked with black silk threads as guides, and the resection was carried out with the usual care to include the regional lymphatics (the superior and inferior gastric and the subpyloric node groups, along the pancreas). The duodenal section was made about 4.0 cm below the tumor border. The duodenal and gastric stumps were closed with three layers of suture for each, an inner continuous Connell suture, with supporting Cushing and Lembert layers. A posterior, short-loop gastrojejunostomy (suture method) completed the operation.

The examination of the removed tissue showed a hard, roughly circular tumor at the pylorus, 5.0 cm in diameter, elevated on the mucous side, and with an excavated centre. The starting point had apparently been in an ulcer at the greater curvature, and extension had occurred along the anterior and posterior walls to make it nearly annular. The microscopic examination by Dr. Francis C. Wood showed an adenocarcinoma, with extension through all the coats of the stomach wall. No metastases were found in the lymph-nodes.

Recovery from the operation was uneventful. The remnant of the stomach began its compensatory enlargement early, and fair-sized meals could be taken within three months. Two months later, the normal full diet as to quantity and kind of food had been resumed. She had an occasional return of the burning sensation and eructation of gas and, at times, sour fluid, but this soon ceased, and she has remained free from symptoms. A recent roentgenogram of the stomach shows the compensatory enlargement of the gastric stump and a well-functioning stoma. Her general condition also is excellent.

DR. JOHN DOUGLAS said that on looking over his own list of cases of cancer of the stomach he found a record of only seven cases which were, to the best of his knowledge, alive three years or more after operation. One, done in November, 1912, is alive, but now in Denver, with tuberculosis of the lungs. Another case done in 1912, was at last report in 1921, perfectly well, nine years after operation. Another case, seventy-one years of age at the time of operation, died five years later of arteriosclerosis. Two were done in 1919, both of whom are well. One case operated on in 1920 has no signs of recurrence. The last one, done in 1920, unquestionably has recurrence at the end of three and a half years. Doctor Semken's remark that a patient, in whom he had removed three-fourths of the stomach, complained of hyperacidity for two or three years, was worthy of note, because it was the general impression that patients who had experienced these extensive resections never had acidity.

DOCTOR SEMKEN, in closing the discussion, said that an important technical detail, in gastric resections for carcinoma, is the removal of the part of the

LATE RESULT AFTER OPERATION FOR CANCER OF STOMACH

great omentum related to the excised segment, because of its lymphatic connection with the cancer field. It is liberated from the transverse colon by an incision along the margin of attachment, and this is practically bloodless.

LATE RESULT AFTER OPERATION FOR CANCER OF TRANSVERSE COLON AND STOMACH

This case presents two points of interest: one, the failure to make an early diagnosis of cancer of the colon, even with expert X-ray examination, and the second, the value of attempting the surgical cure of an advanced and apparently hopeless case of intestinal cancer.

DR GEORGE H. SEMKEN presented a woman, now aged forty-nine years, who came under observation on March 1, 1920. Four months previously, she began to have attacks of cramp-like pain down the outer side of the left lower extremity, which continued for about one month. Following this, she began to have frequent colicky pains in the abdomen, and discomfort from gas eructations, borborygmi and flatus, most marked for about fifteen minutes after eating but occurring also at other times. Her appetite remained good and the bowel movements were regular and normal, but there had been a progressive loss of weight and strength. No other symptoms were observed. In the family history it was noted that her mother had died at the age of twenty-eight years, from cancer of the breast following a suppurative mastitis, but no other cases of cancer had been known. A tentative diagnosis of probable carcinoma of the intestine was made, but a comprehensive X-ray examination by meal and enema, *via* fluoroscope and films (partly stereoscopic), failed to show any significant filling defect or obstruction. A later study of the plates, however, based on the operative knowledge of the site of the disease, showed that a slight but definite deformity in the outline of the colon at that point, had not been recognized as a pathological change.

The patient remained under observation for a few months, during which time she showed some improvement from medical treatment. Six months then passed without a report from her, but even at that time, January 21, 1921, there had been no appreciable change excepting a slight constipation. She had not lost more in weight, the appetite was excellent, there had been no discomfort after meals, and colics were not of daily occurrence. They were noted usually about one hour after eating, or at the time of the bowel movements. After another interval of nearly five months, she again came under observation, and at that time, June 15, 1921, a positive diagnosis could be made. The abdominal colics had continued, but they now began in the epigastrium and extended downward, usually ending in the passing of flatus. There was a bowel movement once in two days, but the feces seemed normal. No mucus or blood had ever been noted. She had had no gastric disturbance; nevertheless there had been a reduction in weight in these five months from 101 pounds to 93 pounds. Examination then showed a palpable firm mass in the abdomen, approximately 60 cm. in diameter, at the left of the umbilicus and behind the outer border of the left rectus muscle. The X-ray examination of the colon by enema, showed a definite filling defect in the transverse colon just proximal to the splenic flexure.

Operation was done on June 22, 1921, under a light narcosis of nitrous oxide gas and oxygen, with the addition of a small amount of ether. The abdomen was opened through an upper left rectus incision, and a tumor approximately 60 cm. in diameter was found in the transverse colon just

proximal to the splenic flexure. It had completely encircled the transverse colon, obliterated the adjacent gastro-colic omentum, invaded the wall of the stomach at the greater curvature, and had become fixed to the anterior abdominal wall over an area of approximately 15 cm diameter. Enlarged lymph-nodes were found along the middle colic vessels down to the pancreas. The liver seemed normal, and there was no ascites. The procedure followed was the block removal of the tumor mass and related nodes, with the resection of the invaded regions of colon and stomach. A circular incision about the anterior abdominal adhesion, dividing the peritoneum and fascia, liberated the mass from the abdominal wall. The splenic flexure and descending colon were mobilized by dissection, after division of the phrenico-colic ligament and the lateral peritoneum, and tapes were tied about the colon, through small openings in the mesocolon, at safe distances proximal and distal to the tumor. These tapes served also as guides and as tractors during the operation. With this preparation, the tumor mass could be lifted out of the abdomen, and an effective walling off with laparotomy pads could be done. The transverse mesocolon was fully exposed by upward traction on the colon, its peritoneum was incised from each tape down to and across the spine, the related lymph-nodes and fatty tissue were dissected from the surface of the pancreas, and, after ligation of the vessels, the transverse mesocolon was divided at its attachment to the posterior abdominal wall. The colon and tumor mass was then drawn downward on the abdominal wall to expose the stomach and the gastro-colic omentum. Beginning at the line of each tape, ligatures were placed in this omentum, close to the greater curvature, ending at safe distances proximal and distal to the tumor, and the gastro-colic omentum was divided through this extent. Flexible intestinal clamps were then applied to the colon at the proposed lines of section next to the tapes, and the colon was divided at those points. The exposed lumen was cleaned with 2 per cent lysol solution, and the intestinal ends were wrapped in moist gauze. Finally the whole tumor mass was raised vertically to expose the stomach wall, a Kocher clamp was applied along the greater curvature at a safe distance from the tumor, and the excluded segment of the greater curvature was cut away. The tissue removed thus comprised the tumor with the related segments of transverse colon, splenic flexure and stomach, the gastro-colic omentum, the transverse mesocolon with the related lymph-nodes, part of the great omentum, and a small segment of the anterior parietal peritoneum and fascia. The opening in the stomach was closed with fine chromic catgut in three layers—first a continuous Connell suture, then a layer of interrupted Lembert seromuscular sutures, and thirdly, a continuous Lembert. The colon was reunited in an end-to-end anastomosis, which had been made possible by the mobilization of the descending colon. Two layers of fine chromic catgut were used—an inner continuous Connell suture and an outer continuous Lembert seromuscular layer. In the technic of the anastomosis, the colon ends were cut obliquely to give a wider lumen (Madelung), and to avoid the cutting of the blood supply from the edges (Lockhart Mummery). The clamps were applied in slightly different axes, to keep the mesenteric borders from coming opposite each other in the suture line (C Mayo). Infection of the triangular mesenteric space was made less likely by closing this space with a hæmostat and ligature (Horsley). Finally, through a small McBurney incision, in the right iliac region, a temporary "gas fistula" was established by inserting a small rubber tube into the cæcum, and forming a channel of intestinal wall about it by Kader's method of suture.

Recovery was uneventful and singularly free from discomfort. The wound healed per primam, and there was no leakage from the cæcostomy when

TRIFACIAL NEURALGIA

the tube was removed, ten days after operation. She has remained well and has gained 28 pounds in weight.

The examination of the tissue removed showed an annular adenocarcinoma of the colon with invasion of the stomach wall. Metastatic deposits were found in two of the related lymph-nodes. The anterior abdominal wall adhesion was inflammatory in origin, and the parietal peritoneum showed no carcinoma.

DR. WILLY MEYER said that he had done the simultaneous resection of stomach and transverse colon for carcinoma in a younger man several years ago. The patient made a good recovery and was presented before the Surgical Society. He went to South America, later on, where he died, as far as could be learned, about eighteen to twenty months after operation. A few years ago a well-known specialist in X-ray therapy, from abroad, was in this country and visited the Lenox Hill Hospital. The surgeons there wanted to show him what final results had been obtained in the operative treatment of cancer, and it was amazing to find how large a number of evidently cured cases were gathered together in a short time. If all surgeons had had a follow-up system many years ago, it could doubtless be proven that many cases have remained cured for many years. The main cause of the failures is that these patients come too late to the surgeon, but even then the surgeon should not hesitate to remove the growth as long as the case appears operable.

TRIFACIAL NEURALGIA

DR. JAMES H. KENYON presented a woman, fifty-one years old, who began to have pain in the right side of her face, twelve years ago, referred to the third division of the fifth nerve. During the next five years, four operations were performed, as these were done in a neighboring city, there is only her statement as to their character. Apparently they were neurectomies, two on the third division behind the angle of the jaw, one on the infra-orbital and one inside the mouth. The last one, inside the mouth, gave relief for one year, none of the other three gave any relief at all.

September, 1919, she came to the Neurological Institute and received an injection of 85 per cent alcohol with 2 per cent novocaine in the third division and had relief for nearly two years. Then the pain returned, but this time in the second division, which was injected, relief for one year. Then pain returned in the third division, which was injected, relief for eleven months, when pain returned in the second division, this was injected, but no relief.

December 18, 1923, she was operated on in the Neurological Institute. The root of the gasserian ganglion was cut, no attempt made to save the motor root. Patient made a good recovery, left the hospital on the tenth day, no complications, complete anaesthesia and analgesia of the entire distribution of the right fifth.

DOCTOR KENYON presented also a man, forty-nine years old, who in 1910 had his first attack of pain, referred to the "eye tooth" left side. Attacks became more frequent and more severe and in 1918 he received his first alcohol injection, second division, left side, relief for eight months. The following year the infra-orbital was resected, relief for ten months. This injection and operation were done by another doctor. October, 1920 the patient came to the Neurological Institute with severe pain in both the second and third divisions, left side. These divisions were both injected 2 c.c. 85 per cent

alcohol, with 2 per cent novocaine in each. Relief for seven months. The next injection gave relief for five months. The following twelve injections gave scarcely any relief, the pain became more severe, one attack quickly following another. In the two years, 1920 to 1922, he received a total of fourteen injections.

September 11, 1922, he was operated on in the Neurological Institute. The root of the ganglion was cut. He made a good recovery, left the hospital on the eighth day. There were no complications, complete anaesthesia and analgesia over the second and third divisions, but scarcely any change over the ophthalmic division. Probably a few fibres in the root were left uncut, as there had never been any pain in this division, it is in a way rather fortunate, as the danger of eye complications are practically nil.

To obtain a clear operative field, free from blood and cerebrospinal fluid, we have found continuous suction very helpful. Regardless of the position of the patient, slightly elevated or sitting upright in a dental chair, a few drops of fluid in the bottom of the wound obscures the structures the surgeon's are working on, this can be continuously removed by the suction without interfering in any way with the operation by the use of a small metal tube, soft copper, that can be curved to best fit the wound. About one-eighth inch in diameter and eight to ten inches long. It may be interesting to note in this connection that the first time that continuous suction was ever employed in this manner was in April, 1906, by Dr. Frank Hartley, and the reporter in an operation for the removal of the gasserian ganglion at the New York Hospital. Suction was produced by using a steam ejector on the high-pressure steam pipe. At the present time nearly every hospital is equipped with some form of suction.

These two cases show that alcoholic injections will give as much relief as any of the neurectomies, either intra- or extra-cranial, are easy to give, can be repeated many times, are practically free from complications if carefully given, and should be the choice of all palliative methods.

The only cure is the operation for dividing the root, and this, with its low mortality and comparatively slight risk to the eye, should not be postponed too long.

DR. ALFRED S. TAYLOR said that the question of alcohol injections is always of interest, but there are many who feel that they are not very serviceable for permanent treatment. At the Neurological Institute they have found that there may be relief for six or seven months and occasionally a case shows relief for as much as two years, but most of them are not relieved for any great length of time, and after a number of injections the intervals of relief are shorter, so that the major operation is regarded as the more satisfactory method of treatment. It would seem that if these patients are young when the neuralgia begins, one might do one alcohol injection, as much to verify the diagnosis as to give relief, for in many cases it is difficult to differentiate between true tic and an affection associated with somewhat similar pain and latter attributes of the involvement of the sympathetic nervous system. Every surgeon who has had many of these fifth nerve cases comes a cropper on some one case (not a true tic), which becomes his nemesis for the rest of his life, for while division of the posterior root gives complete insensibility of the fifth nerve area, the patient complains of pain as great if not greater than before. This happened more frequently before the desirability

CARCINOMA OF THE BREAST

and methods of differentiating were as well understood as now. It is advisable first to do an alcohol injection, and if this does not give relief then we are not dealing with a true uncomplicated tic and the major operation should not be attempted. If relief is experienced by the patient, then the major procedure will make complete relief permanent. In elderly people where death may intervene before the relief following the alcohol injection cases, one may consider the alcohol injection the method of choice. But even here there is room for argument because with most of the cases done now one can use local anæsthesia, so there is little shock or pain even to a patient in the eighties, and one can give them complete relief. One old lady of eighty-two chose the alcohol injection for the first attempt, taking the chance of not surviving long enough for a recurrence, but at the end of two years she underwent the major operation and has had no pain since that time, over five years ago. One can give them relief with local anæsthesia. The amount of suffering from an alcohol injection is more than that experienced from the major operation if the local anæsthesia is well given. The amount of hemorrhage is one-half what it is with general anæsthesia. One of the speaker's patients, a woman, became so nervous that he could not continue the local anæsthesia and gave her general anæsthesia, whereupon the bleeding became twice as much in quantity. That was a concrete example of how much bleeding is saved by local anæsthesia.

CARCINOMA OF THE BREAST BILATERAL RECURRENCE IN THE NECK

DR JAMES H KENYON presented a woman, forty-three years of age, who was admitted to the hospital January 6, 1920, with a small lump in her left breast, noticed about two years before. She thought it had varied in size from time to time, but had never been painful. Examination showed a hard nodular tumor about one inch in diameter, just above and to the inner side of the left nipple. It was moveable on the deeper parts, but the skin over it was adherent. The next day the left breast, both pectorals, axillary contents, glands and fat fascia were removed. The Jabez Jackson incision was employed. The axillary nodes appeared to be normal and no dissection was made above the clavicle. The margins of the wound were undermined and were readily sutured. A cigarette drain was placed through a small stab wound in the axilla. The patient made an excellent recovery, left the hospital on the fourteenth day. She gained weight, had perfect motion of the arm, and never felt better in her life until the latter part of November, 1923 when she thought she had taken cold, her voice became hoarse, and during the next month there was some shortness of breath, a tendency to choke at times and some general fulness of the neck.

Examination shows the old scar and axilla free from any involvement, other breast and axilla normal, but there is a general fulness of the neck and on both sides the nodes, superficial and deep, are much enlarged, hard but not tender. At this present time, February 13th, she can only speak in a whisper. Examination of the larynx shows sluggish movements of the arytenoids and vocal cords, otherwise normal. She has been getting X-ray treatment.

CONTRACTURE OF AXILLARY BURN CICATRIX

DR CARL G BURDICK presented a child, nine years old, with a web contraction of the right axilla following a third degree burn of chest and right axilla occurring in 1919. Admitted to the Children's Surgical Service of Bellevue Hospital in October, 1920, with a contracture of both anterior and posterior folds of the right axilla limiting abduction to about 45 degrees. There was a pocket of normal skin in the apex of the axilla and for this reason an attempt was made to slide a flap from the chest wall reconstructing the anterior fold, the reconstruction of the posterior fold being left for a later date.

One year later the deformity had recurred and in February, 1922, she was readmitted to Bellevue Hospital. The method employed at this time was one suggested by Doctor Abbe. This consisted in piercing and tunnelling the web at a point opposite the apex of the axilla on the normal side. A tubed pedicle flap with the epithelium on the inside was taken from the scapular region and brought through the tunnel, the end being sutured to the anterior incisions in the web and a wick of vaselinated gauze drawn through the tube. Two weeks later the base of the pedicle was cut across and sutured to the margins of the incisions in the posterior web.

The child developed a specific vaginitis and for this reason was not readmitted again to the surgical wards until November, 1922. Operation. A grooved director was passed through the tube and the web and tube divided care being taken to meet the incision in the web enough external so that there would be sufficient flap to entirely form the inner wall of the axilla. The arm could now be fully abducted and the skin flap was sutured to the inner margin of the opened tube graft without tension. A denuded triangular area about 5 cm. on each side was left on the inner side of the arm. A full thickness non-pedicle flap was sutured into this defect, resulting in about a two-thirds take. Care must be taken in dividing the web that none of the nerves from the brachial plexus lie external to the tube. This method is applicable to all cases where a tube can be obtained from either the anterior or posterior chest wall.

Davis, in a recent article on this subject, reports a series of 48 cases and describes several methods, but does not mention this particular one. Two are similar, the first consisting of perforating the web and inserting a glass tube allowing the sinus to epithelize. In the second, he takes one flap from one surface of the web with the pedicle above, the other flap from the other surface of the web with the pedicle below and forms a fistula by suturing the flaps together. This has the disadvantage of taking the flap from the web, which might better be utilized later in covering the denuded areas on the walls of the axilla.

DR GEORGE H SEMKEN believed that in cases of chicken-wing deformity, a recurrence of the deformity is probable if a vertical scar remains in the axilla. To obviate this, a flap is swung across the dissected space from either the anterior or the posterior wound border, preferably the posterior, and the wound left at the site of this flap is covered with a Thiersch graft. The resultant axillary scar is a parabola laid upon its side, and the intervening skin can be freely stretched through the arm movements, after healing has been completed, without danger of contraction.

The plan of operation adopted in correcting the deformity of the lip is

TRAUMATIC FAT NECROSIS OF THE FEMALE BREAST

very ingenious. The problem is difficult when the premaxilla has been removed, as had been done in this case, but Doctor Burdick seems also to have largely overcome the external deformity caused by this earlier procedure.

HARE-LIP

DR CARL G. BURDICK presented a man, aged twenty-nine, who had been operated on in infancy for a double hare-lip. The premaxillary bone had been excised at that time and he was left with the deformity which frequently follows these operations, of a recession and contraction of the upper lip, and a redundancy of the lower lip. The best method of improving this condition is by an operation described by Brophy, but originally performed by Abbe. This consists in first making an incision in the upper lip through its thickness in the median line. This leaves a V-shaped deficiency which is filled by a similar shaped pedicle flap turned up from the lower lip as follows. An incision is made to the left of the centre downwards and inwards to the median line, the length of this incision corresponding to the length of the incision in the upper lip. A vertical incision upwards completes the V, but care must be taken not to carry this so far as to damage the blood supply to the flap. It is easy to estimate the location of the artery from its situation on the other side of the lip. The flap is now turned upwards and to the right and sutured into the deficiency in the upper lip, care being taken to approximate the vermillion borders. A suture is now placed through the two lips on the right side to prevent their separation. The freshened surfaces of the lower lip are now sutured and a Barton bandage applied.

Feeding is accomplished through a tube which can be inserted at the left angle of the mouth.

Ten days to two weeks later the pedicle is divided and swung over to the left and the vermillion border on this side accurately approximated. The operation is completed by freshening and approximating the wounds in the lower lip. If the mouth is too small it can easily be enlarged to the desired size by making an incision at either angle and approximating the skin and mucous membrane.

In the case presented when the pedicle of the flap was divided a second but smaller V was made in the lower lip. An incision was made starting at the original incision in the upper lip just above the vermillion border and carried upwards and outwards, a distance equal to the length of the V. All raw surfaces were freshened and the triangular flap was inserted into this deficiency, which gave considerable added tissue to the upper lip and further decreased the redundancy of the lower lip. The operation was concluded by accurately approximating the vermillion borders of both lips.

TRAUMATIC FAT NECROSIS OF THE FEMALE BREAST

DR BURTON J. LEE read a paper with the above title.

DR FRANK E. ADAIR (by invitation) said that traumatic fat necrosis is a disease of the fat tissue and *not* of the mammary tissue. Practically speaking, it is a disease that occurs in lipomatosis of the breast. Two years ago before the Surgical Section, when discussing the speaker's paper on this disease, Dr Seward Erdman brought up the question, "Why do we not encounter the same condition following a trauma of a very fat abdominal

wall?" The answer would probably be that the abdominal wall has no bony background as does the breast. There is a "give" to the abdominal wall, but the breast receives the full effects of the blow because the chest wall is not elastic.

In acute pancreatitis there is acute necrosis produced in the fat tissue of the omentum which is associated with polymorphonuclear infiltration and the formation of giant cells. In traumatic fat necrosis there is necrosis associated with mononuclear and the formation of giant cells. The pancreatic injury with its tissue reaction is probably a comparable process which occurs in the breast, the former being a very violent tissue reaction while the latter is a slower process.

For the first two or three years following injury the clinical picture of this disease is definitely that of carcinoma. The speaker's cases of eight and ten years following injury presented the appearance of benign tumors.

DR HUGH AUCHINCLOSS thought Doctor Lee's description of fat necroses was valuable because of the necessity for having to consider them in the list of clinically doubtful lesions of the breast. He cited the case of Thayer, who in 1906 reported calcification following introduction of calcium in the mammary region for typhoid hemorrhage. He showed slides of two cases he had studied several years ago, operated on by other surgeons. Both show degeneration areas resembling cystic cavities, one with hemorrhage. The walls of this were made up of innumerable phagocytic cells and giant cells about cholesterol crystal spaces, and containing blood pigment. The wall of the other was made up of granulation tissue containing places where clusters of giant cells enclosed fatty acid crystals. The first was definitely the result of trauma. The second resembled tuberculosis but probably was not.

One thing in common with all these areas of necrosis with carcinoma is the evidence of signs of retraction. He showed slides bearing on the pathogenesis of retraction signs.

DR WILLY MEYER said that he considered that Doctor Lee had added a clinical entity to diseases of the breast. It was clear that the etiology always was traumatism, although in four of the cases mentioned this could not be proven. That made it doubly difficult to differentiate this condition from carcinoma which is often the result of traumatism. It was to be hoped that the originator who established the disease would succeed in learning to make a positive differential diagnosis. For the present it would be wiser in cases of doubt to do a radical operation than to do a local excision. If the pathologist finds the growth is benign, then the patient can be congratulated on its not being carcinoma. The speaker had had opportunity to observe one case of this type lately following extirpation of the breast for cancer of a supernumerary axillary breast. Three small nodules which appeared five months after the radical operation were considered to be due to early recurrence. The pathologist reported fat necroses for all three.

LATE RESULTS OF FRACTURES IN CHILDREN

DOCTOR LEE, in closing the discussion, said that the cases which showed the calcareous deposits were the old cases which have existed for eight or ten years, and these are the ones that are easiest to diagnose. In those which have shown symptoms for a much shorter time, where skin retraction and axillary nodes are present, the diagnosis is much more difficult, as many of the features ordinarily associated with malignant disease are present.

Stated Meeting Held February 27, 1924

The President, DR. EUGENE H. POOL, in the Chair

LATE RESULTS OF FRACTURES IN CHILDREN

DR. KIRBY DWIGHT presented a boy who at the age of eight, two and a half years ago fell from a height of three feet and sustained a fracture of the external condyle of the left humerus. The displacement was considerable and after three unsuccessful attempts to reduce it, the boy was admitted to the hospital for operation. Doctor Dowd operated and removed the fragment, as it was free and had no blood supply. Now there is flexion to 30° , extension to 160° , pronation 90° and supination 90° . There is apparently about a 5° increase in the carrying angle. Practically the function of the arm is complete.

DOCTOR DWIGHT then presented a little girl, who about a year and a half ago when she was seven years old, fell a distance of twenty feet and sustained a fracture of the surgical neck of the left humerus. She was treated by suspension and traction with the arm abducted, but reduction of the displacement was incomplete. There was considerable angular displacement. Now the motions at the shoulder-joint are perfect and the X-ray shows a perfectly normal upper extremity of the humerus.

DOCTOR DWIGHT also presented a girl, who about four years ago, when she was ten years old, fell while roller skating and broke both bones of her right forearm, about two inches above the wrist. There were overriding and angular displacement of both the bones, which could not be reduced. Open reduction was considered and decided against. Now there is no deformity, function is perfect, pronation 70° , supination 90° (on the left side pronation is 85° , supination 90°). The X-rays show hardly a trace of the injury.

DOCTOR DWIGHT presented a lad who two and a half years ago at the age of fifteen, while flying a kite from the roof of his house, ran off the edge of the roof and fell five stories. He was brought to Roosevelt Hospital with a compound fracture of the right femur, lower third and simple fracture of the left femur, lower third. Immediate operation was done, with débridement, open reduction and primary closure of the compound fracture. On account of the great shock the boy was in nothing was done to the other femur at this time. But on the second day following closed reduction

was done on the left femur and it was put up in a plaster-spica Suspension and traction (skin traction) was used for the right femur

Meantime the boy's temperature was very high, about 105° This was thought to be due to a reaction from the tetanus antitoxin, a double dose of which had been given him inadvertently Up to the fourth day the wound was clean, no redness or other sign of infection, but on the fourth day some pus was seen to ooze out from between the sutures The wound was opened widely and a large quantity of foul, colon smelling pus was evacuated Culture showed B Coli Carrel-Dakin treatment was started

On the sixteenth day the boy was running a high temperature A bed-sore was found on the left buttock and the plaster spica was removed and suspension and skin traction applied to the left thigh

By the thirtieth day the patient was in very poor condition looked septic, Temperature 104° each day, right thigh in dreadful condition Amputation advised, but refused by boy's parents

On the thirty-seventh day was transfused Very little hope for his life

Ninth week, signs of abscess at site of fracture in *left* thigh, it was opened and a large quantity of colon bacillus pus was evacuated This was evidently a hæmatogenous infection of the simple fracture of the left femur There were no further hæmatogenous abscesses Blood culture not taken

Tenth week, boy in bad shape, temperature to 104° each day, all effort to keep fragments in position have had to be abandoned, on right side upper fragment protrudes through wound and is apparently dead for several inches, on left side the upper end of the lower fragment has pierced the skin posteriorly just above the popliteal space Suspension with a little traction kept up to facilitate dressings Seems like a painful and useless prolongation of life

Sixteenth week, boy is better, temperature to about 100° each day, Traction removed from both legs, mesial splints applied

Seventeenth week, steady improvement in general condition

Twentieth week, union beginning, both legs

Twenty-fourth week, union firm

Twenty-seventh week, walking on crutches X-ray at this time shows how union may take place sometimes under the most unfavorable conditions Not only were the fragments bathed in pus but they were not even in contact, a space of about an inch on both sides having been bridged by the callus

Union had taken place with the fragments in very poor position, but there *was* union and the boy's life had been spared There was shortening (estimated) on the right side of four and a half inches, on the left side of four inches

Today this boy is strong and healthy He can play and run and jump almost like the other boys His right leg is a half inch shorter than his left His thighs are markedly deformed, but when dressed this deformity does not show

FOREIGN BODY IN DUODENUM OF CHILD

DR CHARLES N DOWD said that for several years he had called attention to the power of repairing fractured bones which is shown in children. He remembered showing a case before this Society in March, 1915 in which marked displacement remained after two efforts to reduce the fracture of both bones of the forearm under anæsthesia and where a picture taken a year later showed practically no deformity. In the intervening period he had seen many cases and had pictures illustrating the good results which had been obtained without operation. There was a notable case, a little more than a year ago, in which a ten year old child of a friend had fractured both bones of the forearm about two inches above the wrist. Three efforts had been made to reduce the deformity under anæsthesia, but they were unsuccessful and marked deformity existed, with the upper fragment of the radius apparently touching the ulna. In order to learn the general feeling as to the proper treatment of these cases, he had shown the X-rays to a number of surgeons and could find no one who advised against operation. In spite of this the forearm was simply left in splints and repeated X-ray photos were taken to watch the repair of the bone. After a few months the repair was apparently perfect and the function perfect, thus giving another example of children's power to repair bone fractures.

It is manifestly unwise to operate on such cases. The speaker had thought much of this problem and had urged Doctor Dwight to take it up and was much pleased to know that he had a large group of cases which illustrated this topic. He had followed many of the cases personally and had verified the good results which Doctor Dwight had obtained.

DR EDWARD D TRUESDELL presented an X-ray of the pelvis and thighs of a child who had had a fracture of the shaft of the femur one year ago. The injured bone was shown to be an inch longer than the bone of the opposite side, due to overgrowth subsequent to the termination of treatment. Fear of permanent shortening is very rarely, if ever, an indication for operation in fractures of the femur in children, as the shortening ordinarily existing at the termination of treatment is uniformly compensated for by a period of accelerated growth, as was shown in the roentgenogram presented and by the investigation of a series of these cases in the follow-up. Doctor Truesdell said that he had removed the fragment in three cases of fracture of the external condyle in children, with results similar to Doctor Dwight's. There was slight increase in the carrying angle, some prominence of the head of the radius, but the elbows were strong and with normal function. He believed this procedure to be indicated in those cases where replacement of the fragment could not be accomplished.

FOREIGN BODY IN DUODENUM OF CHILD

DR EDWARD D TRUESDELL presented a boy, aged fifteen, who on July 3, 1921, accidentally swallowed his scarf pin which he was attempting to straighten with the aid of his teeth. He repaired to a neighboring drug store where he was given an ounce of castor oil which he promptly vomited. In

did not vomit the pin. He applied at St. Luke's Hospital the same day and an X-ray examination determined the presence of the pin in the upper part of his abdomen, probably in the stomach. Repeated X-rays during the next five weeks indicated little change in the position of the foreign body, which, with the aid of bismuth meals, Doctor Le Wald believed to be arrested in the terminal duodenum. August 9, 1921 the abdomen was opened and the pin readily located in the terminal portion of the duodenum, the head, or blunt end, upward. At a location opposite the point of the pin there was firm inflammatory adhesion between that portion of the duodenum and the adjacent jejunum. As this was too firm to yield readily to attempts at separation, an incision was made over the head of the pin, this extracted, and the incision in the duodenum and abdominal wall closed. Recovery was uneventful.

Several years ago the speaker removed an open safety-pin from the duodenum of a child. This had been swallowed several weeks before. The point had penetrated the posterior wall of the duodenum and had caused a retroperitoneal infection. This case shown is interesting because of the size of the object swallowed, because of the arrest of this in the duodenum, and the evident process of stoma formation between duodenum and jejunum, which would soon have released the pin and permitted the continuation of its trip through the intestines. The speaker believed that sharp-pointed objects becoming fixed at some point in the intestinal canal should be promptly removed, before stoma formation or perforation with infection occurred, particularly when of considerable size and definitely located.

DUODENAL OBSTRUCTION FROM TRANSMESENTERIC HERNIA IN AN INFANT

DOCTOR TRUESDELL presented a child, ten months of age, born April 7, 1923 at term, a second child, normal delivery, weight $7\frac{3}{4}$ pounds. When two days old the patient began to vomit and continued to do so. When two weeks old he was transferred to the Pediatric Division of Nursery and Child's Hospital because of persistent vomiting and rapid loss of weight. On examination the baby was found to be emaciated and considerably prostrated. There was no abdominal tumor, no distention, no peristaltic waves. Exploratory laparotomy seemed indicated on account of (1) Persistent vomiting, sometimes projectile, sometimes containing bile, and not controlled by modifications of formulæ. (2) Scant stools. (3) Gastric retention, 80 per cent of test meal after $2\frac{1}{2}$ hours. (4) Bismuth meal X-ray showing retention in stomach and duodenum. (5) Rapid loss of weight ($1\frac{1}{2}$ pounds) and strength.

The pre-operative diagnosis was partial intestinal obstruction, probably due to congenital deformity of intestine.

On April 24, when patient was seventeen days old, the abdomen was opened. The stomach was not dilated. There was no pyloric tumor.

ULCER OF DUODENUM, THIRD PORTION

The duodenum was found dilated because of compression of its terminal portion in passing through an aperture in the upper part of the root of the mesentery from right to left side

The operative procedure consisted in division of the anterior margin of the aperture which was sharply defined and rigid. No other lesion was found. The abdomen was closed.

There was immediate decrease in the tendency to vomit, and the stools became ample. There was no gain in weight for one month, thought to be due to difficulty in adjustment to formula. At three months weight was 7 pounds, at six months $10\frac{1}{2}$ pounds, nine months $13\frac{1}{2}$ pounds, now $14\frac{3}{4}$ pounds.

This case was presented as an instance of infantile vomiting due to an abnormality of the intestine, which might readily be mistaken for a feeding case. To exclude a hypertrophic pyloric stenosis or a complete obstruction does not justify the assumption that persistent vomiting in infancy is a matter of feeding in all cases. There are occasional cases, usually vague but urgent, that lend themselves to surgical treatment.

ULCER OF DUODENUM, THIRD PORTION

DR CARL EGGERS presented a man, thirty years of age who was admitted to the Medical Service of the Lenox Hill Hospital on August 8, 1923. His chief complaint was pain in the right hypochondrium, radiating to the umbilical region, immediately following the ingestion of food, and accompanied by belching of gas. Duration five weeks.

The patient had been well until about six weeks ago when he first noticed burning pain in the epigastrium, which came on $1\frac{1}{2}$ to 2 hours after meals, was not relieved by food, and did not occur during night. About five weeks ago this pain subsided and a different pain developed, situated in the right hypochondrium beneath the costal arch. This pain came on immediately after meals, radiated to the umbilical region and was accompanied by belching of gas. Food did not relieve it. It usually lasted about three hours. There was some radiation to the back, but none to the shoulders. His appetite had been good until two weeks ago, but since then he had been afraid to eat. He frequently vomited after eating but he had never noticed blood. He had lost 15 pounds in weight since onset. There had been no jaundice. He was usually very constipated requiring a laxative daily. There was nothing in his habits or family history of interest in relation to his complaint. On physical examination the only findings were tenderness over the region of the appendix over the right iliac crest, and over the left epigastrium. There was no rigidity and no abnormal masses could be felt. The spleen was enlarged. From the history a gastric or duodenal ulcer was suspected and efforts were made to substantiate this diagnosis. A test meal showed no retention. Free acid 56 total acidity 78. No blood-pressure. The X-ray examination did not reveal any defects in contour of the stomach or the cap. The stomach empty

normally, within the six-hour period. The cæcal region showed deformities suggestive of chronic appendicitis. On the basis of these findings the diagnosis of chronic appendicitis with reflex stomach symptoms was made, and the patient referred to the surgical service.

On August 18, 1923, an incision for exposure of the appendix was made. The latter was small and atrophic and evidently not the cause of the symptoms. It was removed and the stump buried. Further exploration revealed a hard nodular tumor in the right upper abdomen, which seemed to be situated retroperitoneally. It impressed as a mass of glands, and was about the size of a walnut. In order to expose it the incision was enlarged upward. The tumor was found to be retroperitoneal, palpable through the parietal peritoneum and the transverse mesocolon. The former was incised, exposing a pinkish tumor, the anterior surface of which was smooth. Through it, however, a nodular mass could be palpated. From its position it was suspected to be duodenum. In order to make sure an incision was made by which it was found that the lumen of the gut had been opened into. The palpating finger could be passed to the left without interruption, but in the upward direction it was blocked by a hard ulcerating tumor which partly obstructed the lumen. The incision was closed with two rows of fine chromic catgut and the parietal peritoneum then sutured over it. A gastro-enterostomy was decided on. The stomach could not be reached through the existing incision. This was therefore closed and an epigastric incision made. The stomach was found to be normal. The entire anterior surface of the liver was adherent to the abdominal wall. The duodenum which could be reached from above, was normal. A posterior short loop gastro-enterostomy was done, using silk for the inner and outer suture. The abdomen was closed in layers.

The convalescence was uneventful. Immediately after the operation the patient felt relieved, and he has had no pain since. The incision in the duodenum produced no untoward results. At no time were there signs of leakage. Subsequent X-ray pictures showed the stomach entirely empty after three and one-half hours, all food passing through the gastro-enterostomy. The patient was discharged September 16, 1923.

CHRONIC PERFORATING ULCER OF DUODENUM

DR JOHN A. HARTWELL presented three patients, two males and one female, all of whom had suffered from a nearly identical lesion, a large, chronically perforating ulcer of the duodenum extending well down toward its second portion. In every case the ulcer itself was practically destroyed by the perforating process so that on removal of the pylorus and the first portion of the duodenum, only the perforation surrounded in part by inflammatory thickening remained to show the site of the lesion. The perforation was protected by inflammatory exudate in the outer coat and adhesion to the gastrohepatic omentum, the pancreas, or the gall-bladder, it being impossible to determine exactly what structure was the most protective.

CHRONIC PERFORATING ULCER OF DUODENUM

The history was almost identical in all the cases. The ages were thirty-one, thirty-five and thirty-seven years respectively and in each case symptoms typical of duodenal ulcer had been present for five years with increasing severity. In all, the pain had become practically constant during a period of six months and the relief from food and alkalis had become less marked. All had been under more or less dietetic treatment with marked improvement but recurrence later. Vomiting had been a very marked symptom in two of the cases but not in the third. One of the men had vomited blood and passed it with feces in sufficient amount to produce a severe grade of anemia. The other two had been without bleeding which could be clinically diagnosed. An important and distinctive symptom that is infrequently present when the ulcer is not perforating was very marked in all these patients, namely a definite, marked tenderness on pressure in the epigastrium just to the right of the spinal column. This corresponded exactly to the site of the impaired peritoneum over the ulcer.

The diagnosis was confirmed in every case by the fluoroscopic findings at the Cornell Clinic as a "filling defect with fixation of the first portion of the duodenum." In cases so evident as these we do not deem it necessary to take films except for purposes of teaching or additional record. The Gastro-enterological Department at Cornell has made a larger per cent of correct findings by the fluoroscope alone than by films alone. The latter are only used when the clinical diagnosis and the fluoroscopic diagnosis are not in accord.

In all of these cases a resection was done from the pyloric antrum to the second portion of the duodenum. In all, great difficulty was experienced in closing the duodenal stump because the ulcer had encroached so closely to the papilla that satisfactory inversion was not practicable. They were therefore closed by a through-and-through suture of chromic catgut and one or two layers of peritoneal sutures reinforced by burying against the pancreas or covering by omentum, as seemed more efficient. The reestablishment of the alimentary lumen varied in the three cases.

In one man, the least involved, a typical Billroth II was performed, while in the other two the jejunum was anastomosed to the proximal end of the stomach according to Polya. In the woman, the more proximal portion of the jejunal stoma was at the greater curvature of the gastric stoma, while in the third case it was at the lesser curvature, there was thus a complete reversal of the jejunum in the third case but not in the second. In the latter, post-operative vomiting was a very marked symptom and great care in diet with lavage was needed for three or four weeks to overcome this. Such did not occur in the other cases. This is somewhat comparable with experience in posterior gastro-enterostomy though at the present time most surgeons lay the jejunum against the stomach in this operation, depending on the natural fall of the loop to obtain the most satisfactory emptying of the stomach.

The selection in these two cases was made upon this principle but a

further study shows that simple posterior gastro-enterostomy is not exactly comparable to the Polya type in this particular. The open end of the stomach when drawn through the incision in the transverse mesocolon looks downward and to the right, the greater curvature being dependent and fairly movable, while the lesser curvature is obliquely above it and comparatively fixed. Thus, with the proximal end of the jejunal lumen at the gastric curvature the stomach contents being propelled along the more active greater curvature is prone to enter the jejunum against the current and dam up there. Again, the jejunal content has a more direct route into the stomach when the antiperistalsis of the stomach is active during digestion. These factors do not hold when the proximal end of the jejunal stoma is at the lesser curvature, and this therefore seems the method of choice. In the most advanced case, the man who had had severe bleeding, the closure of the duodenal stump proved imperfect and leakage took place and lasted for ten days. To our surprise, this closed spontaneously and, except for the breaking down of the wound, no ill effects resulted.

Certain technical points are employed in all these cases as a routine. The abdominal incision is always made vertically through the middle of the anterior rectus sheath and the inner leaf of this sheath lifted up to the midline. The entire rectus is dislocated outward and the posterior sheath together with the peritoneum incised near the midline where the structures are strong. These two are clamped together during the operation and later sutured as one layer at the close of the operation, the rectus being restored to its normal position and the anterior sheath sutured with care. When drainage is needed, as in gall-bladder cases, or acute gastric or duodenal perforation, it is done through a stab wound in the side entering Morrison's pouch. Our experience makes us believe that hernia is less frequent by this method than by others. The actual anastomoses are made without the use of clamps, the field being protected with gauze pads. All unions are made with careful suturing of the mucosa, the submucosa and the peritoneal and muscular coats. Actual hæmostasis is obtained by clamping and ligating and there is no inverting stitch used, except on the outer layer which we are careful not to have penetrate the submucosa.

Section of the stomach and bowel is always made with the knife and the edges are always touched with carbolic acid and alcohol. These procedures give excellent coaptation of the various layers of the stomach and bowel, make post-operative bleeding impossible and, on the final healing of the anastomoses, leave a freely moving mucosa over the other structure of the wall.

A specimen removed at autopsy in a case of œsophageal pharyngeal cancer where a gastrostomy was done illustrates this point. One portion of the trap door in the Janeway operation was sutured by a "loop on mucosa" stitch while another part was sutured by the method here described. The contrast is marked, the latter showing a nicely united mucosal tissue moving over the underlying coats while the former showed much more scar tissue and greater fixation of the mucosa. An additional safeguard

RESECTION OF STOMACH FOR ULCER

against production of ulcer similar to the marginal type in gastro-jejunostomy is furnished by this layer to layer method of suture

DUODENAL ULCER RESECTION OF DUODENUM AND ANTRUM OF THE STOMACH

DR HERMANN FISCHER presented a man who had suffered from stomach trouble for fourteen years. Three years ago was operated upon in another hospital for an epigastric hernia. After this operation he felt a little better, but soon his cramp-like pain in the epigastrium returned in intervals of two weeks. This condition continued until September, 1923, when he vomited for the first time and his pain became almost continuous and very severe.

Findings at operation. Ulcer on the antero-superior surface of the duodenum near the pylorus. Dense adhesions along the duodenum running to the hepato-duodenal ligament as well as fine adhesions between the pancreas and the posterior wall of the duodenum. The duodenal wall surrounding the ulcer is infiltrated and oedematous. After the duodenum had been thoroughly freed from all adhesions, it appeared so well mobilized that a resection of the duodenum with pylorus and antrum of the stomach was feasible. This was done and 11 cm of the lesser curvature and 15 cm of the greater curvature of the stomach were removed together with the ulcer bearing area of the duodenum. As the remaining stump of the duodenum showed some infiltration, the original plan of doing a Billroth I operation was abandoned and a Billroth II after Balfour-Polya was done. Insertion of Einhorn duodenal tube for immediate feeding. Uneventful recovery.

RESECTION OF STOMACH FOR ULCER

DOCTOR FISCHER presented a man who fourteen months ago began to have pain of a sharp and burning character in the epigastrium which occurred about one hour after meals. He was treated in a hospital in Austria for some weeks and left from there somewhat improved. He felt fairly well until ten weeks ago when his distress came back in its old intensity. He lost about fifteen pounds in weight. He vomits occasionally but never noticed blood in his vomitus. Bowels are constipated, no blood in stool, as far as he knows. Physical examination negative, except for pain and tenderness in epigastrium. X-ray reveals a large penetrating ulcer at the lesser curvature. Inflammatory adhesions are involving the pyloric end of the stomach to such an extent that they interfere with the normal emptying power.

Operation November 3, 1921, splanchnic anesthesia. A large penetrating ulcer of the lesser curvature of the stomach was found. It has penetrated posteriorly and adherent to the pancreas. Resection of about one-half of stomach after Polya-Balfour. Patient left table in good condition and made an uneventful recovery.

DOCTOR FISCHER presented also a woman who on account of stomach

trouble lasting for several months, with loss of twenty pounds in weight, was subjected to operation December 30, 1922. On opening of abdomen very extensive adhesions were found, running from the free border of the liver to the stomach and from there on to the anterior abdominal wall. The adhesions were so dense and extensive that the whole anterior surface of the stomach and the gall-bladder were buried by them. After freeing the organs from this mass of adhesions it was found that they had to deal with a large hour-glass stomach, caused by the penetrating ulcer, situated half-way between the pylorus and the cardia, the two sacs being of almost equal size. Resection of almost two-thirds of the stomach with antrum and pylorus was done, by Billroth I method. Einhorn tube feeding. Uneventful recovery.

DOCTOR FISCHER finally presented a man who, after having suffered from stomach trouble for twenty years, and having been treated for a long time and repeatedly medically without benefit, was operated upon by him. On opening of abdomen indurated mass of the size of a plum was found at the lesser curvature about two inches away from the pylorus. Impossible to decide whether carcinoma or indurated ulcer. Glands enlarged along lesser and greater curvature. Resection of pylorus and about half of stomach. Billroth I. Einhorn tube feeding. Uneventful recovery.

CHRONIC DUODENAL AND GASTRIC ULCER, PRESENT STATUS OF SURGICAL TREATMENT

DR CHARLES H. PECK read a paper with the above title for which see ANNALS OF SURGERY for July, 1924.

DOCTOR PECK presented seven patients to illustrate his paper.

DR CHARLES N. DOWD said that the group of cases which give the most satisfactory results in stomach surgery are of course, those who have pyloric stenosis. The recovery is marvelous and there is usually freedom from complications. These cases, however, are not now seen in as great proportion as they used to be. They used to represent about 20 per cent of his own surgical stomach cases but the proportion is now less because the conditions which produced stenosis are now treated at an earlier period and cicatricial contracture does not follow.

The most pressing question at the present time is the treatment of ulcers in or near the duodenum, since they are far more common than those in the stomach itself. Personally the speaker's experience has been like Doctor Peck's, that cases of duodenal ulcer treated by gastro-enterostomy do well. They show marked improvement and enjoy reasonably good health. It seems fair to believe that the diminished acidity of the stomach contents and the change in the mode of its exit from the stomach may easily account for this improvement. Next to the operation for pyloric stenosis and the operation for perforated ulcer, the gastro-enterostomy for duodenal ulcer seems to form the most satisfactory group of stomach operations.

When the ulcer extends so as to be both on the duodenal and stomach

CHRONIC DUODENAL AND GASTRIC ULCER

sides of the pylorus one meets one of the most puzzling problems which we have. The question of pylorotomy then arises. One does not wish to do a pylorotomy on a case which will be cured by a gastro-enterostomy nor does one wish to omit a pylorotomy on a case which may really be malignant. The amount of induration which exists about a simple ulcer in this locality is often so great that it really feels like malignancy. He had several times had the experience of doing a primary gastro-enterostomy in the expectation of doing a later pylorotomy, being confident that the pylorotomy would be much easier after the inflammatory induration had subsided, and at the second operation found that no evidence of induration remained. It is surely safe to omit a pylorotomy on a very large proportion of these patients.

DR JOHN DOUGLAS said that he was in complete accord with each and every one of the conclusions of Doctor Peck's timely and most excellent paper, and as he could not criticize any of his conclusions, he could only perhaps try to add to his argument.

It was his belief that the results of gastro-enterostomy with excision of the ulcer when feasible, if the operation is properly indicated and correctly performed and the patient given suitable after care, gives better results than generally accepted. It must be acknowledged at the start that gastro-enterostomy is not an ideal operation, even if associated with removal of the ulcer by cautery or excision, as it does not attack directly the etiological factors influencing ulcer formation. But no one knows the exact cause of the chronic indurated ulcer of the stomach or duodenum, or why it recurs, and even the experimental work of Mann and others of sidetracking the duodenal alkali flow, and the work of Roseneau and his followers along the line of specific streptococcus infection, has not cleared everything up so as to make obvious the ideal operation. The fact must be accepted that certain complications occur and various conditions cause a certain percentage of poor after results, two to three or even some say five per cent of jejunal ulcer, two per cent of hemorrhage, occasionally a gastrocolic fistula, very rarely a perforation, and that there are a certain number of cases who still complain of gastric symptoms after their operation. It is these patients who return many many times with their difficult problems while the cured cases are lost sight of.

It is a bit difficult to reconcile the difference in the reports of the results of gastro-enterostomy in the American and some of the European clinics. Mayo states 90 per cent of satisfactory results were obtained in duodenal ulcer cases without excision. Ninety-five per cent were cured surgically, but more than one operation was necessary. Finny 77 per cent cured by gastro-enterostomy and 88 per cent by pyloroplasty, Pool 84 per cent, Deaver 80 per cent well and 10 per cent markedly improved, Schroeder 63 per cent, Peck 80 to 90 per cent. In contrast to these figures Finsterlin in a recent lecture given in New York quotes Pavr as having 62 per cent re-

eries and 37 per cent failures, Bier 66 per cent recoveries and Harberer 37 per cent of recoveries

If these latter figures are correctly quoted, it is but natural that there should be dissatisfaction with the results and different methods attempted and this led to the radical operation of resection of the pylorus and antral portions of the stomach by Harberer, Lorenz, Schur, and others on the theory of removing that portion of the stomach which secreted a hormone that activated the acid-producing glands of the fundus

One cannot deny that except in the hands of the surgeon most qualified by experience in gastric surgery, such procedure must have a higher mortality than simple excision or gastro-enterostomy or both, and to justify it either the theory on which it is founded must be proved correct or the results obtained must be manifestly superior. As to the theory, Smithies insists that ulcer occurs without hyperacidity and all surgeons have seen many such cases. As to the results, to quote Finsterer again. He states that ulcer in the duodenum or at the anastomosis "were already observed in 29 cases" and Harberer himself has reported three cases after antral resection, and Cole and Hoguet have reported a large marginal ulcer surrounding the stoma following a Polya resection. For this reason, Finsterer advocated resection of more than two-thirds of the stomach, with the portion of the duodenum containing the ulcer, or if the duodenum cannot be removed, the resection of the stomach leaving the ulcer. This he calls the atypical operation. He reports 94 per cent of cures and a surprisingly low mortality—372 cases of (gastric and duodenal) resection for duodenal ulcer with 3.6 per cent mortality, but he has had a large experience stating that he has done more than 700 resections in the past twelve years and does practically all of his work with local and regional anaesthesia.

Since June, 1918, there have been at St. Luke's Hospital 123 operations for duodenal ulcer. The follow-up record on these cases has been as carefully kept as possible. Doctor Douglas said he was not prepared to give the statistics in detail, but of 95 cases followed for from six months to five years, 81 are reported as cured or 86 per cent and nine or 9.5 reported improved. Only five or 4.5 per cent are reported as unimproved. Of the uncomplicated cases, excluding 22 cases of perforated ulcer, one case of obstructive jaundice and one of pernicious in which the ulcers were complications and not primary lesions, there were four deaths in 108 cases or 3.7 per cent.

Seeing many of these cases personally and talking with the other members of the staff who have examined the patients, the speaker believed that good results can be obtained with the use of gastro-enterostomy with excision when possible, or with pyloroplasty. That a correctly and carefully performed operation and a properly sized and placed stoma is essential, and that after care both in respect to diet, alkalies, intestinal hygiene and removal of possible foci of infection will further improve the results so that the radical operations of partial gastrectomy for duodenal ulcer will not be necessary or advisable.

CHRONIC DUODENAL AND GASTRIC ULCER

DR WALTER A BASTEDO (by invitation) said that there were some cases that were obviously medical and some that were obviously surgical. It was just as wrong for a medical man to treat a surgical case as it was for a surgeon to operate on every case that came to him just because it was ulcer. On the other hand, there is a middle class of cases in which one might be in doubt in the choice of medical or surgical treatment. If these cases, however, are not curable by medical means, this can be readily proven by trial. Undoubtedly medical men do have a little prejudice against surgery because so many post-operative cases come to them with distress and trouble, especially after gastro-enterostomy. Such he believes to be fewer now than previously, owing to the great improvement in surgery. It is obvious that duodenal ulcer cases are in a class entirely different from stomach cases. The latter are more serious. All duodenal cases are not serious, there are always the menaces of extension, hemorrhage and perforation, but many of these ulcers are carried for years without anything serious happening. But that is not often the case in stomach ulcer and here there is the added menace there of carcinoma developing. Not long ago a surgeon said that medical treatment does not obviate the possibility of cancerous development. But medical treatment, if it cures the ulcer, is just as successful in preventing cancer in that area as surgical treatment. Besides, it is known that many cases have developed cancer after surgery and many supposed ulcers have turned out to be cancer when examined by the pathologist. Most of the surgeons are pessimistic when there is cancer there, for even these supposed ulcers, though really cancer cases, generally die ultimately of cancer, no matter what operation is done. Doctor Bastedo favors the excision of the ulcer when this is possible, for this is the only hope from a cancer point of view. There was one condition in which medical treatment had the advantage over surgical—the diagnosis of ulcer was sometimes made when there is no ulcer, and in such case surely it is better for the patient to have a medical cure than to be opened up and have the surgeon discover that no ulcer is present. He asked the surgeons how often such an event happens. Another thing of very great interest is that sometimes after a perfectly good gastro-enterostomy and in the presence of a well-working stoma, new ulcers develop, not marginal or jejunal, but in the body of the stomach or the duodenum, in other words, the procedure which was done for the express purpose of putting the stomach in a condition favorable to the cure of ulcer permits the development of new ulcers. Yet, as a rule, gastro-enterostomy is successful in the cure of ulcer, and is an operation that he would not wish abolished.

DR JOHN F ERDMANN called attention to the operation of Horsley as the most satisfactory from the standpoint of cure as far as ulcer was concerned because it excised the ulcer, did not make a new stoma and the surgeon could see the field of operation and attend to kissing or contact ulcers when present. Since the 30th of June 1920 Doctor Erdmann has done 44 Horsley operations, and in the same period of time there were 133 operations on or about the duodenum. Another reason why he had selected the Horsley was

on account of the number of marginal ulcers he had had referred to him during the last six or seven years. On two occasions he had reported some seven or eight cases. He felt that any operation which would reduce this possibility would be the natural operation of choice. The subsequent symptomatology is far more satisfactory than from the other operations. He had had several late marginal ulcers, one case presented recently in which the ulcer was evident ten years after the original operation. He felt that the Horsley operation cannot be done in all cases of duodenal ulcer, when not feasible then a resection or gastro-enterostomy should be done. He stated that his series of Horsley operations is as yet too small and too recent for a positive declaration, but that the reasons for doing it are well defined. In regard to the antecolic operation of Polya, this he had debarred the past year from his service on account of obstruction following in three patients and he was under the impression that this operation is being dropped in other clinics, the operators reverting to the original Polya or some form of Billroth.

DR. WILLY MEYER said he took the same position that Doctor Peck had done with regard to the surgical treatment of duodenal ulcer. He considered the subject so large that he could only select a few points for discussion. Mention had been made of pyloric occlusion, his best functional and clinical results had been seen upon this addition and for a while he had practiced it in every case he operated on. If one occludes the pylorus, however, the effect of the presence of bile, which usually enters the stomach after gastro-enterostomy and neutralizes the acidity, is lost for the healing of the duodenal ulcer. Therefore, pyloric occlusion is undesirable.

Many cases are due to syphilis. The report frequently reads "Wassermann negative," but that is not proof of the absence of syphilis. On one occasion lately the speaker found an infiltration which passed over the entire first portion of the duodenum and then on to the stomach. On further examination this was found to be specific.

Doctor Meyer said he also favored Doctor Peck's technic in doing the operation. But after the division of the seromuscular coat of the stomach, he liked to put in a few catgut stitches around the visible vessels before dividing the mucosa. In regard to the vicious circle only lately the speaker had had such a case in spite of the short-loop operation. He then used the button for an additional entero-enterostomy and the patient got well. He never united the split in the transverse mesocolon to the jejunum, but attached it to the stomach. Surgeons certainly have seen excellent results from gastro-enterostomy. Why, then, not do a gastro-enterostomy first and, if the patient does not get well, a resection at the second stage? One should first do the operation which involves the least danger.

CORRESPONDENCE

TRAUMATIC AVULSION OF THE SCAPULA

EDITOR ANNALS OF SURGERY

Sn

In April 1910 while I was surgeon for a large copper mining hospital in Arizona, a Mexican Indian twenty-five years of age, from the State of Jalisco, was engaged in greasing the bearings of a shaft in the smelter in which he was employed. His sleeve became caught in the shafting and the left scapula, with the arm attached, was torn from his body. A first-aid dressing was applied, an ambulance summoned and he arrived at the hospital about twenty minutes after the accident occurred. He was in marked shock but there was no active bleeding. There was no artery that required ligation. The wound was dressed while special care was taken to cause the minimum disturbance to the patient. He was then put to bed, hot-water bags applied and 750 cc. of normal salt solution with 1 cc. of adrenalin added was given intravenously.

The accident happened about eight p. m. Next morning he still showed evidence of shock but was much improved. He took plenty of fluids during the day and on the following morning, thirty-

six hours after the accident, his condition was so good that he was given an ether anesthesia and the wound trimmed up and closed. A few ragged pieces were removed from the muscles in the depths of the wound and the skin flaps were approximated with silkworm sutures. The skin flaps readily covered the wound, due evidently to the fact that the sharp edge of the scapula, when

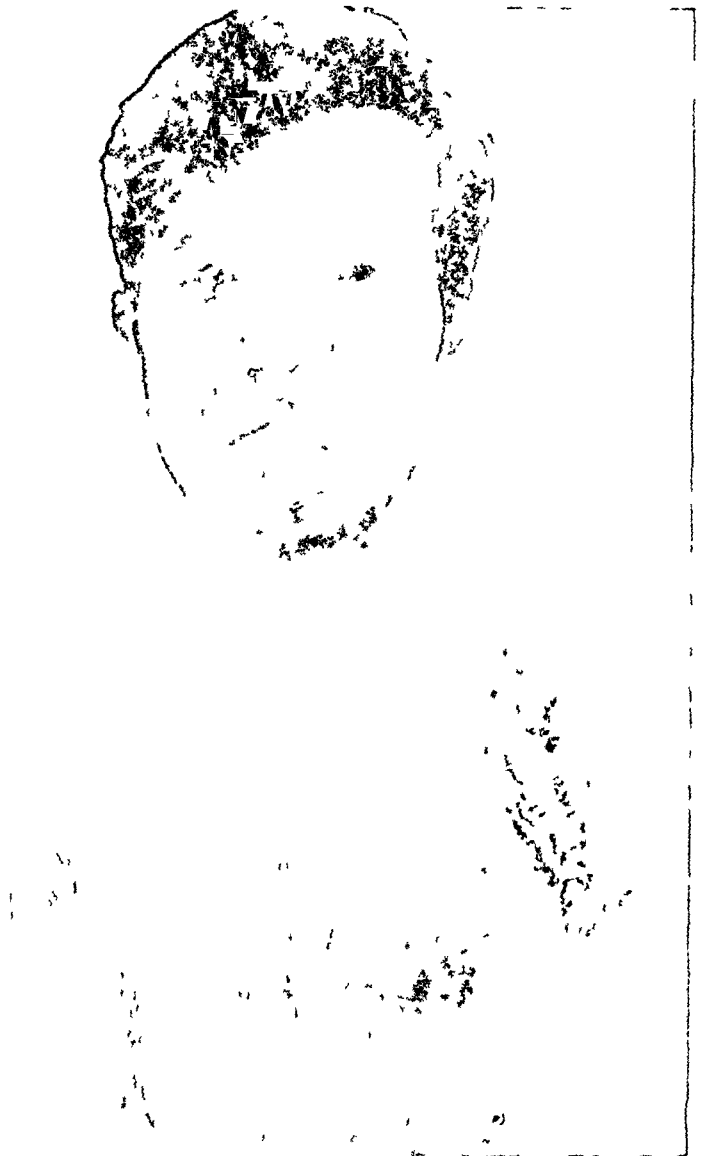


FIG. 1.—Avulsion of scapula, condition of patient four weeks after the accident.

dragged out had cut its own skin-flaps on the way out. There was no area to heal by granulation as the flaps covered everything perfectly. The after-convalescence was uninterrupted, and the man was discharged from the hospital with his wound completely healed in four weeks. There was no suppuration in the wound at any time. A noticeable thing about this patient was the fortitude he displayed at all times. He never complained and his unfailing response to queries as to how he felt was a smile and the word "bueno." Possibly this stoical heritage from his Indian ancestors was an important factor in the smooth recovery that he made.

I add a brief resume of former cases reported in the literature.

- I BRAITHWAITE, J. Lond M Gaz, 1832, vol xi, p 147. Boy, twelve. Arm caught in strap of carding machine. Profuse bleeding. Recovery.
- II LOND M GAZ 1830 vol v, p 497. Boy eleven. Arm caught in chain attached to steam engine. Recovered in three months.
- III CHARLES, J. J. Lancet Lond, 1872, vol i, p 216. Boy, ten. Caught arm in machinery in mill. Separation was not complete. Surgeon completed amputation and tied axillary vessels. Recovery.
- IV CHLSELDEN, W. Anatomy Human Body, Lond, 1897, 321, 1 pl. Cites case that happened in 1737. Arm caught in rope in mill. Little bleeding. Recovery.
- V COOPER, J. S. N York, J M, 1843, vol i, p 284. Boy, seven. Caught in machinery around sugar mill. Two-thirds scapula torn off. Remainder removed. Recovery.
- VI GEORGE, W. H. Eclect M J Cincin, 1897, vol xxxiv, pp 69-72. Miner caught in shaft of mine by descending cage. Little hemorrhage. Recovery.
- VII JONES, J. E. Lancet, Lond, 1881, vol ii, p 363. Miner, seventeen, caught in shafting. Axillary artery ligated by surgeon. Little hemorrhage. Good recovery.
- VIII JONES, T. E. Brit M J Lond, 1870, vol i, p 545. Boy, eleven, caught in rope attached in revolving shaft. Some hemorrhage and shock. Axillary and two small arteries tied. Recovery.
- IX LEWIS, R. F. North Car M J, Wilmington, 1882, vol v, pp 197-200. Man, twenty-six. Caught in machinery of steam mill. Little hemorrhage. Recovery.
- X LOWE, Lancet, Lond, 1867, vol ii, p 611. Man, eighteen. Caught in carding machine. Axillary artery ligated. Little hemorrhage. Recovery.
- XI LUNN, Brit M J, Lond, 1871, vol i, p 340. Boy, four. Arm caught in spokes of wagon wheel. Separation of scapula from body not complete. No hemorrhage. Recovery.
- XII MARSHALL, EWING. N York M J, 1899, vol lxx, p 730. Boy, twelve. Hand caught between pulley and belt. Axillary artery ligated. Recovery.
- XIII MUSSRY, R. D. Am J M Sc, Phila, 1837, vol xxi, pp 385-388. Boy, sixteen. Caught in machinery of cotton factory. Little hemorrhage. Recovery.
- XIV PATMORE, T. D. Brit M J Lond, 1903, vol i, p 134. Man, seventeen. Accident not described. Recovery. Worked as postal clerk.
- XV SCARNELL, B. F. Lancet, Lond, 1831-2, vol ii, p 114. Boy, thirteen. Caught in machinery in mill. Axillary artery ligated. Recovery.
- XVI WALI, GREGORY A. J. Oklahoma M Assn, Guthrie, 1918, vol xi, p 315. Young man caught in revolving machinery. Very little hemorrhage. Severe shock. Operated in twenty-four hours. Skin graft done sixteen days later. Wound fully healed in two months.
- XVII WILI, J. C. O. Brit M J Lond, 1884, vol i, p 1135. Girl, eighteen. Arm caught in revolving cylinder. No hemorrhage. Much shock. Good recovery.

CORRESPONDENCE

In reviewing the literature one is strikingly impressed with the absence of severe hemorrhage. The torsion on the vessels during the process of avulsion evidently is a most excellent aid to efficient blood clot formation. In nine of the reported cases, as well as in our case, absence of bleeding is noted. Also in view of the fact that all injuries were due to machinery and some time necessarily elapsed before skilled care could be given, any of the cases had opportunity for fatal hemorrhage.

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GALL-BLADDER DISEASE IN YOUTH

EDITOR ANNALS OF SURGERY

Sir

In a recent paper in the ANNALS OF SURGERY (May, 1923,) I reported a case of gall-stones in a child eleven years of age and collected from the literature sixty-four cases of gall-bladder disease in children ranging from an eight months fetus to fifteen years of age, justifying the conclusion that infections of the gall-bladder in early life are not so rare as has been supposed. The following additional cases are offered as further evidence in support of this conclusion.

CASE I—J. H., a girl, eighteen years of age, was admitted to Gouverneur Hospital, October 11, 1923. She never had had attacks similar to that for which she applied for admission. Two weeks before she had suffered from an attack of indigestion which was not severe and quickly subsided. On the evening of the onset she retired feeling well but was awakened at three A.M. with pain in both hypochondriac regions, more marked on the right. The pain extended to the back but not to the shoulder blade. It was continuous and cramp-like and after about an hour, was accompanied with vomiting of green-colored fluid. The bowels moved following an enema. When admitted to the hospital she appeared quite ill and was slightly jaundiced. She complained of pain in both upper quadrants of the abdomen extending to the back on the right side. There was rigidity of upper right rectus and tenderness in the region of the gall-bladder. Temperature, 100, leucocyte count, 12,000, pulse 104, polymorphonuclears, 92 per cent, respiration, 20. Operation was performed the day of admission. The gall-bladder was found acutely inflamed, greatly distended, did not empty on pressure. Stones could be palpated in the gall-bladder but not in the ducts. Cholecystectomy with drainage was done. The gall-bladder was found to be much thickened and contained a large number of hard stones. Result: Uneventful recovery followed.

CASE II—S. B., a girl, aged fifteen years, was admitted to Gouverneur Hospital, November 18, 1923. She had been well until two weeks before, when she complained of slight abdominal pain and anorexia. The symptoms subsided under medical treatment. Four days ago she suddenly developed severe general abdominal pain with persistent vomiting. After several days' treatment at home she was brought to the hospital. On admission she appeared acutely ill. She was not jaundiced. There was a board-like rigidity of the entire abdomen, general tenderness to both light and deep pressure. Temperature, 101.2, urine contained a little albumen, pulse, 120, leucocyte count, 12,500, respiration, 33, polymorphonuclears, 90 per cent. Operation was performed immediately. Upon opening the abdominal cavity a general peritonitis was presented. There was a large amount

CORRESPONDENCE

of bile-stained fluid in the abdomen, the appendix was congested, the gall-bladder was acutely inflamed and covered with bile-tinged exudate, upon its fundus was a small perforation, three stones were palpated, one in the cystic duct and two in the gall-bladder. Cholecystostomy and drainage of abdomen was done. She died in four days from peritonitis.

CASE III—G. E., a young married woman, aged twenty-two years, was admitted to the New York Polyclinic Hospital, April 19, 1916. Three months previously she had given birth to a child, after a difficult labor. For several weeks prior to coming to the hospital she had had frequent attacks of severe epigastric pain extending to the back, no jaundice and no fever. When admitted she showed marked tenderness under right and left costal arch with rigidity of upper right rectus. The abdomen was opened soon after admission to the hospital. The gall-bladder was found contracted, bound to the liver by dense adhesions and containing numerous small stones, adhesions about the appendix. Cholecystectomy and appendectomy was done. Uneventful recovery followed.

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To Contributors and Subscribers

All contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 145 Gates Ave., Brooklyn, N. Y.

Remittances for Subscriptions and Advertising and all business communications should be addressed to the

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227-231 S. 6th Street

Philadelphia, Penna.

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